N61165.AR.002790
CNC CHARLESTON
5090.3a

FINAL RESOURCE CONSERVATION AND RECOVERY FACILITY INVESTIGATION ZONE J STORM WATER EFFLUENT EVALUATION REPORT ADDENDUM VOLUME 1 OF 4 SECTIONS 1 TO 4 CNC CHARLESTON SC

12/1/2002

ENSAFE/ ALLEN AND HOSHALL

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
CTO-0154

ZONE J RFI STORM WATER EFFLUENT EVALUATION REPORT ADDENDUM

REVISION: 0

VOLUME I OF IV - SECTIONS 1 TO 4

SOUTHDIV Contract Number:
N62467-89-D-0318

Prepared for:

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA

Prepared by:

ENSAFE INC.
313 WINGO WAY
MOUNT PLEASANT, SOUTH CAROLINA 29464
(843) 884-0029

DECEMBER 2002

Release of this document requires the prior notification of the Commanding Officer of the Southern Division, Naval Facilities Engineering Command, Naval Base Charleston, South Carolina

CERTIFICATION PAGE

REGISTERED SOUTH CAROLINA PROFESSIONAL ENGINEER CERTIFICATION.

I certify that the data and interpretations presented in this *Zone J Storm Water Effluent Evaluation Report Addendum* are true and accurate to the best of my knowledge as a registered South Carolina Professional Engineer.

Henry Fellers, P.E. Registration Number 19318	Date

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY
CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA
CTO-0154

ZONE J RFI STORM WATER EFFLUENT EVALUATION REPORT ADDENDUM

SOUTHDIV Contract Number:
N62467-89-D-0318

Prepared for:

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA

Prepared by:

ENSAFE INC.
313 WINGO WAY
MOUNT PLEASANT, SOUTH CAROLINA 29464
(843) 884-0029

The Contractor, EnSafe Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0318 is complete, accurate, and complies with all requirements of the contract.

Date:	**December 2002**
Signature:	_____
Name:	**Charles A. Vernoy**
Title:	**Task Order Manager**

Table of Contents

ABBREVIATIONS, ACRONYMS, AND SYMBOLS xx

EXECUTIVE SUMMARY xxv

1.0 INTRODUCTION 1.1

2.0 HYDRODYNAMICS OF THE COOPER RIVER 2.1
- 2.1 Freshwater Inflow 2.1
- 2.2 Tides 2.2
- 2.3 Tidal Currents 2.3
- 2.4 Tidal Flows 2.7
- 2.5 Circulation and Tidal Excursion 2.8
- 2.6 Water Quality 2.10
- 2.7 Drainage 2.13

3.0 DATA VALIDATION 3.1
- 3.1 Introduction 3.1
- 3.2 Validation Summary 3.1
- 3.3 Organic Evaluation Criteria 3.3
- 3.4 Diluted Samples 3.3
- 3.5 Inorganic Evaluation Criteria 3.4
- 3.6 Zone J Data Validation Reports 3.4
- 3.7 Blank Data 3.4
- 3.8 Method Detection Limit 3.7

4.0 DRAINAGE BASIN EVALUATIONS 4.1
- 4.1 Drainage Basin Evaluations for the Cooper River 4.1
- 4.2 Drainage Basin 1 ..... 4.8
  - 4.2.1 Potential Source Areas 4.8
    - 4.2.1.1 SWMU 2 Site Description and History 4.8
    - 4.2.1.2 SWMU 38 Site Description and History 4.12
    - 4.2.1.3 SWMU 39 Site Description and History 4.15
  - 4.2.2 Storm Water Effluent Evaluation 4.20
  - 4.2.3 Pathway Evaluation 4.21
- 4.3 Drainage Basin 2 ..... 4.22
  - 4.3.1 Potential Source Areas 4.22
    - 4.3.1.1 SWMU 2 Site Description and History 4.22
    - 4.3.1.2 SWMU 39 Site Description and History 4.26
  - 4.3.2 Storm Water Effluent Evaluation 4.30
  - 4.3.3 Pathway Evaluation 4.31
    - 4.3.3.1 Scenario 1a 4.32
    - 4.3.3.2 Scenario 1b 4.32
    - 4.3.3.3 Scenario 1c 4.33
    - 4.3.3.4 Scenario 1d 4.33

4.3.4 Summary of Potential COPCs 4.34
4.4 Drainage Basin 3 ..... 4.35
4.4.1 Potential Source Areas 4.35
4.4.1.1 SWMU 2 Site Description and History 4.35
4.4.1.2 SWMU 39 Site Description and History 4.39
4.4.2 Storm Water Effluent Evaluation 4.44
4.4.3 Pathway Evaluation 4.45
4.4.3.1 Scenario 1a 4.46
4.4.3.2 Scenario 1b 4.46
4.4.3.3 Scenario 1c 4.48
4.4.3.4 Scenario 1d 4.49
4.4.4 Summary of Potential COPCs 4.49
4.5 Drainage Basin 18 ..... 4.50
4.5.1 Potential Source Areas 4.50
4.5.1.1 AOC 507 Site Description and History 4.50
4.5.2 Storm Water Effluent Evaluation 4.52
4.5.3 Pathway Evaluation 4.53
4.5.3.1 Scenario 1a 4.54
4.5.3.2 Scenario 1b 4.54
4.5.3.3 Scenario 1c 4.55
4.5.3.4 Scenario 1d 4.55
4.5.4 Summary of Potential COPCs 4.55
4.6 Drainage Basin 20 ..... 4.56
4.6.1 Potential Source Areas 4.56
4.6.1.1 SWMU 47 and AOC 516 Site Description and History ... 4.57
4.6.1.2 AOC 508 and AOC 511 Site Description and History 4.59
4.6.1.3 AOC 517 Site Description and History 4.61
4.6.1.4 AOC 518 Site Description and History 4.62
4.6.1.5 AOC 526 Site Description and History 4.64
4.6.2 Storm Water Effluent Evaluation 4.65
4.6.3 Pathway Evaluation 4.66
4.6.3.1 Scenario 1a 4.67
4.6.3.2 Scenario 1b 4.68
4.6.3.3 Scenario 1c 4.69
4.6.3.4 Scenario 1d 4.70
4.6.4 Summary of Potential COPCs 4.70
4.7 Drainage Basin 22 ..... 4.72
4.7.1 Potential Source Areas 4.72
4.7.1.1 SWMU 21 and SWMU 54 Site Description and History . 4.73
4.7.1.2 AOC 528 Site Description and History 4.76
4.7.2 Storm Water Effluent Evaluation 4.77
4.7.3 Pathway Evaluation 4.78
4.7.3.1 Scenario 1a 4.79
4.7.3.2 Scenario 1b 4.79
4.7.3.3 Scenario 1c 4.79
4.7.3.4 Scenario 1d 4.80

4.7.4 Summary of Potential COPCs 4.80
4.8 Drainage Basin 23 ..... 4.81
4.8.1 Potential Source Areas 4.81
4.8.1.1 SWMU 22, SWMU 25, and AOC 554 Site Description and History 4.82
4.8.1.2 SWMU 23, SWMU 63, AOC 540, AOC 541, AOC 542 and AOC 543 Site Description and History 4.86
4.8.1.3 SWMU 65 and AOC 544 Site Description and History ... 4.91
4.8.1.4 SWMU 67 Site Description and History 4.94
4.8.1.5 SWMU 70, AOC 548, and AOC 549 Site Description and History 4.95
4.8.1.6 AOC 530 Site Description and History 4.99
4.8.1.7 AOC 531 Site Description and History 4.100
4.8.1.8 AOC 538 and 559 Site Description and History 4.102
4.8.1.9 AOC 550 Site Description and History 4.104
4.8.2 Storm Water Effluent Evaluation 4.106
4.8.3 Pathway Evaluation 4.107
4.8.3.1 Scenario 1a 4.107
4.8.3.2 Scenario 1b 4.108
4.8.3.3 Scenario 1c 4.108
4.8.3.4 Scenario 1d 4.109
4.8.4 Summary of Potential COPCs 4.109
4.9 Drainage Basin 26 ..... 4.110
4.9.1 Potential Source Areas 4.110
4.9.1.1 SWMU 65 Site Description and History 4.110
4.9.1.2 AOC 550 Site Description and History 4.112
4.9.2 Storm Water Effluent Evaluation 4.114
4.9.3 Pathway Evaluation 4.115
4.9.3.1 Scenario 1a 4.115
4.9.3.2 Scenario 1b 4.116
4.9.3.3 Scenario 1c 4.116
4.9.3.4 Scenario 1d 4.116
4.9.4 Summary of Potential COPCs 4.117
4.10 Drainage Basin 27 ..... 4.118
4.10.1 Potential Source Areas 4.118
4.10.1.1 SWMU 25 Site Description and History 4.118
4.10.1.2 AOC 549 Site Description and History 4.121
4.10.1.3 AOC 559 Site Description and History 4.123
4.10.1.4 AOC 551 and AOC 552 Site Description and History ... 4.125
4.10.2 Storm Water Effluent Evaluation 4.126
4.10.3 Pathway Evaluation 4.127
4.10.3.1 Scenario 1a 4.128
4.10.3.2 Scenario 1b 4.128
4.10.3.3 Scenario 1c 4.129
4.10.3.4 Scenario 1d 4.130
4.10.4 Summary of Potential COPCs 4.130

4.11 Drainage Basin 28 ..... 4.131
4.11.1 Potential Source Areas 4.131
4.11.1.1 SWMU 170 and SWMU 171 Site Description and History 4.132
4.11.1.2 AOC 520 Site Description and History 4.133
4.11.1.3 AOC 522 Site Description and History 4.134
4.11.1.4 AOC 523 Site Description and History 4.136
4.11.1.5 AOC 559 Site Description and History 4.137
4.11.1.6 AOC 569, AOC 570 and AOC 578 Site Description and History 4.139
4.11.2 Storm Water Effluent Evaluation 4.142
4.11.3 Pathway Evaluation 4.142
4.11.3.1 Scenario 1a 4.143
4.11.3.2 Scenario 1b 4.143
4.11.3.3 Scenario 1c 4.144
4.11.3.4 Scenario 1d 4.144
4.11.4 Summary of Potential COPCs 4.144
4.12 Drainage Basin 30 ..... 4.145
4.12.1 Potential Source Areas 4.145
4.12.1.1 Combined SWMU 83 (includes SWMU 84 and AOC 574) Site Description and History 4.146
4.12.1.2 Combined SWMU 87 (includes SWMU 172 and AOC 564) Site Description and History 4.150
4.12.1.3 Combined SWMU 170 (includes SWMU 171) Site Description and History 4.153
4.12.1.4 AOC 559, AOC 560, and AOC 561 Site Description and History 4.155
4.12.1.5 AOC 562 Site Description and History 4.157
4.12.1.6 AOC 563 Site Description and History 4.159
4.12.1.7 AOC 569, AOC 570, and AOC 578 Site Description and History 4.160
4.12.1.8 AOC 572 Site Description and History 4.163
4.12.1.9 AOC 573 Site Description and History 4.165
4.12.1.10 AOC 576 Site Description and History 4.167
4.12.1.11 AOC 579 Site Description and History 4.169
4.12.1.12 AOC 580 Site Description and History 4.170
4.12.2 Storm Water Effluent Evaluation 4.171
4.12.3 Pathway Evaluation 4.172
4.12.3.1 Scenario 1a 4.173
4.12.3.2 Scenario 1b 4.174
4.12.3.3 Scenario 1c 4.176
4.12.3.4 Scenario1d 4.177
4.12.4 Summary of Potential COPCs 4.177
4.13 Drainage Basin 30-A 4.178
4.13.1 Potential Source Areas 4.178
4.13.1.1 AOC 567 Site Description and History 4.178

4.13.2 Storm Water Effluent Evaluation 4.179
4.13.3 Pathway Evaluation 4.180
4.13.3.1 Scenario 1a 4.181
4.13.3.2 Scenario 1b 4.181
4.13.3.3 Scenario 1c 4.182
4.13.3.4 Scenario 1d 4.182
4.13.4 Summary of Potential COPCs 4.183
4.14 Drainage Basin 31 ..... 4.184
4.14.1 Potential Source Areas 4.184
4.14.1.1 AOC 566 Site Description and History 4.184
4.14.1.2 AOC 567 Site Description and History 4.186
4.14.2 Storm Water Effluent Evaluation 4.187
4.14.3 Pathway Evaluation 4.188
4.14.3.1 Scenario 1a 4.188
4.14.3.2 Scenario 1b 4.189
4.14.3.3 Scenario 1c 4.190
4.14.3.4 Scenario 1d 4.190
4.14.4 Summary of Potential COPCs 4.190
4.15 Drainage Basin 32 ..... 4.191
4.15.1 Potential Source Areas 4.191
4.15.1.1 SWMU 145 Site Description and History 4.192
4.15.1.2 SWMU 188 Site Description and History 4.193
4.15.1.3 AOC 576 Site Description and History 4.194
4.15.1.4 AOC 583 Site Description and History 4.196
4.15.2 Storm Water Effluent Evaluation 4.198
4.15.3 Pathway Evaluation 4.198
4.15.3.1 Scenario 1a 4.199
4.16 Drainage Basin 33 ..... 4.200
4.16.1 Potential Source Areas 4.200
4.16.1.1 SWMU 97 Site Description and History 4.200
4.16.1.2 AOC 586 Site Description and History 4.202
4.16.2 Storm Water Effluent Evaluation 4.203
4.16.3 Pathway Evaluation 4.204
4.16.3.1 Scenario 1a 4.204
4.16.3.2 Scenario 1b 4.204
4.16.3.3 Scenario 1c 4.204
4.16.3.4 Scenario 1d 4.206
4.16.4 Summary of Potential COPCs 4.206
4.17 Drainage Basin 34 ..... 4.207
4.17.1 Potential Source Areas 4.207
4.17.1.1 SWMU 100 Site Description and History 4.207
4.17.1.2 SWMU 102 Site Description and History 4.209
4.17.1.3 SWMU 109 Site Description and History 4.211
4.17.1.4 AOC 607 Site Description and History 4.213
4.17.1.5 AOC 609 Site Description and History 4.218
4.17.2 Storm Water Effluent Evaluation 4.219

4.17.3 Pathway Evaluation 4.220
4.17.3.1 Scenario 1a 4.221
4.17.3.2 Scenario 1b 4.221
4.17.3.3 Scenario 1c 4.221
4.17.3.4 Scenario 1d 4.222
4.17.4 Summary of Potential COPCs 4.222
4.18 Drainage Basin 35 ..... 4.223
4.18.1 Potential Source Areas 4.223
4.18.1.1 SWMU 102 Site Description and History 4.223
4.18.1.2 AOC 590 Site Description and History 4.225
4.18.1.3 AOC 596 Site Description and History 4.226
4.18.1.4 AOC 613 Site Description and History 4.228
4.18.2 Storm Water Effluent Evaluation 4.230
4.18.3 Pathway Evaluation 4.231
4.18.3.1 Scenario 1a 4.232
4.19 Drainage Basin 36 ..... 4.233
4.19.1 Potential Source Areas 4.233
4.19.1.1 AOC 596 Site Description and History 4.233
4.19.1.2 AOC 598 Site Description and History 4.235
4.19.2 Storm Water Effluent Evaluation 4.236
4.19.3 Pathway Evaluation 4.237
4.19.3.1 Scenario 1a 4.238
4.20 Drainage Basin 37 ..... 4.239
4.20.1 Potential Source Areas 4.239
4.20.1.1 SWMU 3 Site Description and History 4.240
4.20.1.2 SWMU 24 Site Description and History 4.243
4.20.1.3 AOC 607 Site Description and History 4.244
4.20.1.4 AOC 609 Site Description and History 4.249
4.20.1.5 AOC 611 Site Description and History 4.251
4.20.1.6 AOC 613 Site Description and History 4.252
4.20.2 Storm Water Effluent Evaluation 4.255
4.20.3 Pathway Evaluation 4.256
4.20.3.1 Scenario 1a 4.257
4.20.3.2 Scenario 1b 4.257
4.20.3.3 Scenario 1c 4.258
4.20.3.4 Scenario 1d 4.259
4.20.4 Summary of Potential COPCs 4.259
4.21 Drainage Basin 38 ..... 4.260
4.21.1 Potential Source Areas 4.260
4.21.1.1 SWMU 4/AOC 619 Site Description and History 4.261
4.21.1.2 AOC 602 Site Description and History 4.263
4.21.1.3 AOC 613/AOC 615 Site Description and History 4.264
4.21.1.4 AOC 616 Site Description and History 4.266
4.21.1.5 AOC 617 Site Description and History 4.267
4.21.2 Storm Water Effluent Evaluation 4.269
4.21.3 Pathway Evaluation 4.269

4.21.3.1 Scenario 1a 4.270
4.21.3.2 Scenario 1b 4.270
4.21.3.3 Scenario 1c 4.271
4.21.3.4 Scenario 1d 4.271
4.21.4 Summary of Potential COPCs 4.272
4.22 Drainage Basin 39 ..... 4.273
4.22.1 Potential Source Areas 4.273
4.22.1.1 SWMU 106 and AOC 603 Site Description and History 4.273
4.22.2 Storm Water Effluent Evaluation 4.275
4.22.3 Pathway Evaluation 4.276
4.22.3.1 Scenario 1a 4.277
4.23 Drainage Basin 40 ..... 4.278
4.23.1 Potential Source Areas 4.278
4.23.1.1 SWMU 106 and AOC 603 Site Description and History 4.278
4.23.1.2 AOC 602 Site Description and History 4.280
4.23.2 Storm Water Effluent Evaluation 4.282
4.23.3 Pathway Evaluation 4.282
4.23.3.1 Scenario 1a 4.283
4.24 Drainage Basin 41 ..... 4.284
4.24.1 Potential Source Area 4.284
4.24.1.1 SWMU 5, SWMU 18, AOC 605 Site Description and History 4.285
4.24.1.2 AOC 604 Site Description and History 4.288
4.24.1.3 AOC 620 Site Description and History 4.289
4.24.2 Storm Water Effluent Evaluation 4.291
4.24.3 Pathway Evaluation 4.292
4.24.3.1 Scenario 1a 4.292
4.24.3.2 Scenario 1b 4.293
4.24.3.3 Scenario 1c 4.294
4.24.3.4 Scenario 1d 4.295
4.24.4 Summary of Potential COPCs 4.295
4.25 Drainage Basin 42-A 4.296
4.25.1 Potential Source Area 4.296
4.25.2 Storm Water Effluent Evaluation 4.296
4.25.3 Pathway Evaluation 4.297
4.25.3.1 Scenario 1a 4.298
4.25.3.2 Scenario 1b 4.298
4.25.3.3 Scenario 1c 4.298
4.25.3.4 Scenario 1d 4.299
4.25.4 Summary of Potential COPCs 4.299
4.26 Drainage Basin 43 ..... 4.300
4.26.1 Potential Source Areas 4.300
4.26.1.1 SWMU 4 and AOC 619 Site Description and History ... 4.301
4.26.1.2 SWMU 36 and AOC 620 Site Description and History . 4.303
4.26.1.3 SWMUs 6, 7, and AOC 635 Site Description and

History 4.305
4.26.1.4 AOC 628 Site Description and History 4.308
4.26.1.5 AOC 633 Site Description and History 4.309
4.26.2 Storm Water Effluent Evaluation 4.311
4.26.3 Pathway Evaluation 4.313
4.26.3.1 Scenario 1a 4.313
4.27 Drainage Basin 43A/43B 4.315
4.27.1 Potential Source Areas 4.315
4.27.1.1 SWMU 120 Site Description and History 4.315
4.27.1.2 AOC 638 Site Description and History 4.317
4.27.2 Storm Water Effluent Evaluation 4.319
4.27.3 Pathway Evaluation 4.321
4.27.3.1 Scenario 1a 4.321
4.28 Drainage Basin 44 ..... 4.323
4.28.1 Potential Source Areas 4.323
4.28.1.1 SWMU 8 and AOC 636 Site Description and History ... 4.324
4.28.1.2 AOC 638 Site Description and History 4.326
4.28.2 Storm Water Effluent Evaluation 4.328
4.28.3 Pathway Evaluation 4.329
4.29 Drainage Basin 45 ..... 4.330
4.29.1 Potential Source Areas 4.330
4.29.1.1 SWMU 8 Site Description and History 4.330
4.29.1.2 AOC 642 Site Description and History 4.332
4.29.1.3 AOC 643 Site Description and History 4.334
4.29.2 Storm Water Effluent Evaluation 4.336
4.29.3 Pathway Evaluation 4.337
4.29.3.1 Scenario 1a 4.338
4.29.3.2 Scenario 1b 4.338
4.29.3.3 Scenario 1c 4.339
4.29.3.4 Scenario 1d 4.340
4.29.4 Summary of Potential COPCs 4.340
4.30 Drainage Basin 47 ..... 4.341
4.30.1 Potential Source Areas 4.341
4.30.1.1 SWMU 13/AOC 659 Site Description and History 4.342
4.30.1.2 SWMU 17 Site Description and History 4.344
4.30.1.3 AOC 672/AOC 673 Site Description and History 4.348
4.30.1.4 AOC 653 Site Description and History 4.349
4.30.1.5 AOCs 655/656 Site Description and History 4.352
4.30.1.6 AOC 671 Site Description and History 4.355
4.30.1.7 Other Impacted Areas G07 and G38 Site Description and History 4.357
4.30.2 Storm Water Effluent Evaluation 4.359
4.30.3 Pathway Evaluation 4.362
4.30.3.1 Scenario 1a 4.363
4.30.3.2 Scenario 1b 4.363
4.30.3.3 Scenario 1c 4.364

4.30.3.4 Scenario 1d 4.365
4.30.4 Summary of Potential COPCs 4.365
4.31 Drainage Basin 47A 4.366
4.31.1 Potential Source Areas 4.366
4.31.1.1 SWMU 177/RTC Site Description and History 4.366
4.31.2 Storm Water Effluent Evaluation 4.368
4.31.3 Pathway Evaluation 4.369
4.31.3.1 Scenario 1a 4.370
4.31.3.2 Scenario 1b 4.370
4.31.3.3 Scenario 1c 4.371
4.31.3.4 Scenario 1d 4.371
4.31.4 Summary of Potential COPCs 4.371
4.32 Drainage Basin 47B 4.372
4.32.1 Potential Source Area 4.372
4.32.1.1 SWMU 37 Site Description and History 4.372
4.32.2 Storm Water Effluent Evaluation 4.374
4.32.3 Pathway Evaluation 4.374
4.32.3.1 Scenario 1a 4.375
4.32.3.2 Scenario 1b 4.375
4.32.3.3 Scenario 1c 4.376
4.32.3.4 Scenario 1d 4.376
4.32.4 Summary of Potential COPCs 4.376
4.33 Drainage Basin 48 ..... 4.377
4.33.1 Potential Source Areas 4.377
4.33.1.1 SWMU 13 Site Description and History 4.378
4.33.1.2 SWMU 136 and AOC 663 Site Description and History 4.379
4.33.1.3 SWMU 178 Site Description and History 4.382
4.33.1.4 SWMU 660 Site Description and History 4.383
4.33.1.5 SWMU 665 Site Description and History 4.385
4.33.1.6 SWMU 679 Site Description and History 4.396
4.33.1.7 Other Investigation Areas G80 Site Description and History 4.388
4.33.1.8 SWMU 177/RTC Site Description and History 4.390
4.33.2 Storm Water Effluent Evaluation 4.392
4.33.3 Pathway Evaluation 4.394
4.33.3.1 Scenario 1a 4.395
4.33.3.2 Scenario 1b 4.395
4.33.3.3 Scenario 1c 4.396
4.33.3.4 Scenario 1d 4.396
4.33.4 Summary of Potential COPCs 4.396
4.34 Drainage Basins 48A to 48G 4.397
4.34.1 Potential Source Areas 4.397
4.34.1.1 AOCs 675/676/677 Site Description and History 4.398
4.34.1.2 AOCs 678/679 Site Description and History 4.400
4.34.1.3 AOC 680 Site Description and History 4.401

4.34.2 Storm Water Effluent Evaluation 4.403
4.34.3 Pathway Evaluation 4.406
4.34.3.1 Scenario 1a 4.407
4.34.3.2 Scenario 1b 4.407
4.34.3.3 Scenario 1c 4.408
4.34.3.4 Scenario 1d 4.409
4.34.4 Summary of Potential COPCs 4.409
4.35 Drainage Basin 48H 4.410
4.35.1 Potential Source Areas 4.410
4.35.1.1 AOC 681 Site Description and History 4.410
4.35.2 Storm Water Effluent Evaluation 4.413
4.35.3 Pathway Evaluation 4.414
4.35.3.1 Scenario 1a 4.414
4.35.3.2 Scenario 1b 4.415
4.35.3.3 Scenario 1c 4.415
4.35.3.4 Scenario 1d 4.416
4.35.4 Summary of Potential COPCs 4.416
4.36 Drainage Basin 49 ..... 4.417
4.36.1 Potential Source Areas 4.417
4.36.1.1 AOC 666 Site Description and History 4.418
4.36.1.2 AOC 680 Site Description and History 4.420
4.36.1.3 AOC 681 Site Description and History 4.422
4.36.2 Storm Water Effluent Evaluation 4.424
4.36.3 Pathway Evaluation 4.425
4.36.3.1 Scenario 1a 4.425
4.36.3.2 Scenario 1b 4.426
4.36.3.3 Scenario 1c 4.426
4.36.3.4 Scenario 1d 4.426
4.36.4 Summary of Potential COPCs 4.427
4.37 Drainage Basin 51 ..... 4.428
4.37.1 Potential Source Areas 4.428
4.37.1.1 SWMU 17 Site Description and History 4.428
4.37.1.2 AOC 667/SWMU 138 ..... 4.432
4.37.2 Storm Water Effluent Evaluation 4.434
4.37.3 Pathway Evaluation 4.436
4.37.3.1 Scenario 1a 4.437
4.37.3.2 Scenario 1b 4.437
4.37.3.3 Scenario 1c 4.438
4.37.3.4 Scenario 1d 4.439
4.37.4 Summary of Potential COPCs 4.439
4.38 Drainage Basin 51C 4.440
4.38.1 Potential Source Area 4.440
4.38.1.1 SWMU 16/AOC 687 Site Description and History 4.440
4.38.2 Storm Water Effluent Evaluation 4.442
4.38.3 Pathway Evaluation 4.443
4.38.3.1 Scenario 1a 4.443

4.38.3.2 Scenario 1b 4.444
4.38.3.3 Scenario 1c 4.444
4.38.3.4 Scenario 1d 4.445
4.38.4 Summary of Potential COPCs 4.445
4.39 Drainage Basin 53 ..... 4.446
4.39.1 Potential Source Areas 4.446
4.39.1.1 AOC 607 Site Description and History 4.447
4.39.1.2 AOC 609 Site Description and History 4.450
4.39.1.3 SWMU 611 Site Description and History 4.452
4.39.2 Storm Water Effluent Evaluation 4.454
4.39.3 Pathway Evaluation 4.455
4.39.3.1 Scenario 1a 4.456
4.39.3.2 Scenario 1b 4.456
4.39.3.3 Scenario 1c 4.457
4.39.3.4 Scenario 1d 4.457
4.39.4 Summary of Potential COPCs 4.457
4.40 Clouter Island 4.458
4.40.1 Potential Source Areas 4.458
4.40.1.1 AOC 693/AOC 694 Site Description and History 4.459
4.40.1.2 AOC 695 Site Description and History 4.461
4.40.2 Storm Water Effluent Evaluation 4.462
4.40.3 Pathway Evaluation 4.462
4.40.4 Summary of Potential COPCs 4.462

5.0 CONTAMINANT RELEASE HISTORY FOR CHARLESTON HARBOR 5.1

6.0 CONCLUSIONS 6.1

7.0 REFERENCES 7.1

8.0 SIGNATORY PAGE 8.1

List of Figures

Figure 2-1 CNC Delineated Basins
Figure 4-1 Cooper River Drainage Basins and Outfalls
Figure 4-2 Drainage Basin 1
Figure 4-3 Drainage Basin 2
Figure 4-4 Drainage Basin 3
Figure 4-4A Drainage Basin 3 Soil Sample Linkage Locations
Figure 4-4B Drainage Basin 3 Groundwater Linkage Locations
Figure 4-5 Drainage Basin 18
Figure 4-6 Drainage Basin 20
Figure 4-6A Drainage Basin 20 Soil Sample Linkage Locations (West)

Figure 4-6B Drainage Basin 20 Soil Sample Linkage Locations (East)
Figure 4-6C Drainage Basin 20 Groundwater Sample Linkage Locations
Figure 4-7 Drainage Basin 22
Figure 4-8 Drainage Basin 23
Figure 4-8A Drainage Basin 23 Soil Sample Linkage Locations
Figure 4-9 Drainage Basin 26
Figure 4-10 Drainage Basin 27
Figure 4-11 Drainage Basin 28
Figure 4-12 Drainage Basin 30
Figure 4-12A Drainage Basin 30 Soil Sample Linkage Locations
Figure 4-12B Drainage Basin 30 Groundwater Sample Linkage Locations
Figure 4-13 Drainage Basin 30A
Figure 4-14 Drainage Basin 31
Figure 4-15 Drainage Basin 32
Figure 4-16 Drainage Basin 33
Figure 4-17 Drainage Basin 34
Figure 4-18 Drainage Basin 35
Figure 4-19 Drainage Basin 36
Figure 4-20 Drainage Basin 37
Figure 4-20A Drainage Basin 37 Soil Sample Linkage Locations
Figure 4-20B Drainage Basin 37 Groundwater Sample Linkage Locations
Figure 4-21 Drainage Basin 38
Figure 4-22 Drainage Basin 39
Figure 4-23 Drainage Basin 40
Figure 4-24 Drainage Basin 41
Figure 4-24A Drainage Basin 41 Soil Sample Linkage Locations
Figure 4-25 Drainage Basin 42A
Figure 4-26 Drainage Basin 43
Figure 4-27 Drainage Basin 43A/43B
Figure 4-28 Drainage Basin 44
Figure 4-29 Drainage Basin 45
Figure 4-29A Drainage Basin 45 Soil Sample Linkage Locations
Figure 4-30 Drainage Basin 47
Figure 4-30A Drainage Basin 47 Soil Sample Linkage Locations
Figure 4-31 Drainage Basin 47A
Figure 4-32 Drainage Basin 47B
Figure 4-33 Drainage Basin 48
Figure 4-34 Drainage Basin 48A to 48G
Figure 4-35 Drainage Basin 48H
Figure 4-36 Drainage Basin 49
Figure 4-37 Drainage Basin 51
Figure 4-37A Drainage Basin 51 Soil Sample Linkage Locations
Figure 4-38 Drainage Basin 51C
Figure 4-39 Drainage Basin 53
Figure 4-40 Clouter Island

List of Tables

Table 2.1 Tidal Ranges and Phases in Charleston Harbor/Cooper River 2.3
Table 2.2 Tidal Ranges and Phases in Ashley River 2.5
Table 2.3 Tidal Ranges and Phases in Wando River 2.5
Table 2.4 Tidal Current Velocities and Phases in Charleston Harbor and Cooper River.. 2.5
Table 2.5 Tidal Current Velocities and Phases in Ashley River 2.7
Table 2.6 Tidal Current Velocities and phases in Wando River 2.8
Table 2.7 Flow Measurements in Charleston Harbor Estuary 2.8
Table 2.8 Water Quality Data at Cooper River Above Shipyard Creek 2.11
Table 2.9 Water Quality Data at Cooper River at Noisette Creek 2.12
Table 2.10 Water Quality Data at Cooper River at I-526 ..... 2.12
Table 2.11 Cooper River Stormwater Outfall Inventory 2.14
Table 2.12 Summary of Surface Runoff to Cooper River along the CNC shoreline 2.19
Table 2.13 Surface Runoff Summary for Drainage Basins 2.22
Table 2.14 Percentage of Particle Mass in Stormwater 2.23
Table 3.1 Charleston Naval Complex Analytical Program 3.2
Table 3.2 STL/Savannah MDL Study for SVOCs 3.7
Table 3.3 STL/Savannah MDL Study for Pesticides/PCBs 3.10
Table 3.4 STL/Savannah MDL Study for Metals by Low-Level ICP Method 3.11
Table 3.5 STL/Savannah MDL Study for Mercury by Cold Vapors 3.12
Table 3.6 STL/Savannah MDL Study for Miscellaneous Organics 3.13
Table 4.0 Zone J Screening Criteria for Sample Media 4.1
Table 4.1 Cooper River Drainage Basins 4.2
Table 4.2.1 Drainage Basin 1 SWMUs/AOCs 4.8
Table 4.2.2 Summary of SWMU 2 Investigations 4.9
Table 4.2.3 Summary of SWMU 38 Investigations 4.12
Table 4.2.4 Summary of SWMU 39 Investigations 4.15
Table 4.2.5 Storm Water Effluent Sampling Results, Drainage Basin 1 ..... 4.20
Table 4.3.1 Drainage Basin 2 SWMUs/AOCs 4.22
Table 4.3.2 Summary of SWMU 2 Investigations 4.23
Table 4.3.3 Summary of SWMU 39 Investigations 4.26
Table 4.3.4 Storm Water Effluent Sampling Results, Drainage Basin 2 ..... 4.31
Table 4.3.5 Storm Water Contaminant Migration Pathway Scenario Summary, DB 2 ..... 4.32
Table 4.4.1 Drainage Basin 3 SWMUs/AOCs 4.35
Table 4.4.2 Summary of SWMU 2 Investigations 4.36
Table 4.4.3 Summary of SWMU 39 Investigations 4.39
Table 4.4.4 Storm Water Effluent Sampling Results, Drainage Basin 3 ..... 4.44
Table 4.4.5 Storm Water Contamination Migration Pathway Scenario Summary, DB 3 .... 4.45
Table 4.4.6 Drainage Basin 3, Scenario 1b Catch Basin Evaluation 4.47
Table 4.4.7 Drainage Basin 3, Scenario 1c Catch Basin Evaluation 4.48
Table 4.4.8 Summary of Potential COPCs, Drainage Basin 3 ..... 4.49
Table 4.5.1 Drainage Basin 18 SWMUs/AOCs 4.50
Table 4.5.2 Summary of AOC 507 Investigations 4.51
Table 4.5.3 Storm Water Effluent Sampling Results, Drainage Basin 18 ..... 4.53

Table 4.5.4 Storm Water Contaminant Migration Pathway Scenario Summary, DB 18 ..... 4.54
Table 4.6.1 Drainage Basin 20 SWMUs/AOCs 4.56
Table 4.6.2 Summary of SWMU 47/AOC 516 Investigations 4.57
Table 4.6.3 Summary of AOC 508/AOC 511 Investigations 4.60
Table 4.6.4 Summary of AOC 517 Investigations 4.61
Table 4.6.5 Summary of AOC 518 Investigations 4.63
Table 4.6.6 Summary of AOC 526 ..... 4.64
Table 4.6.7 Storm Water Effluent Sampling Results, Drainage Basin 20 ..... 4.66
Table 4.6.8 Storm Water Contaminant Migration Pathway Scenario Summary, DB 20 ..... 4.67
Table 4.6.9 Drainage Basin 20 Scenario 1b Catch Basin Evaluation 4.68
Table 4.6.10 Drainage Basin 20 Scenario 1c Catch Basin Evaluation 4.70
Table 4.6.11 Summary of Potential COPCs 4.70
Table 4.7.1 Drainage Basin 22 SWMUs/AOCs 4.72
Table 4.7.2 Summary of SWMU 21 and SWMU 54 Investigations 4.73
Table 4.7.3 Summary of AOC 528 Investigations 4.76
Table 4.7.4 Storm Water Effluent Sampling Results, Drainage Basin 22 ..... 4.78
Table 4.7.5 Storm Water Contaminant Migrations Pathway Scenario Summary, DB 22 .... 4.78
Table 4.8.1 Drainage Basin 23 SWMUs/AOCs 4.82
Table 4.8.2 Summary of SWMU 22, SWMU 25, and AOC 554 Investigations 4.83
Table 4.8.3 Summary of SWMU 23, SWMU 63, AOC 540, AOC 541, AOC 542, and AOC 543 Investigations 4.87
Table 4.8.4 Summary of SWMU 65 and AOC 544 Investigations 4.91
Table 4.8.5 Summary of SWMU 67 Investigations 4.94
Table 4.8.6 Summary of SWMU 70, AOC 548, and AOC 549 Investigations 4.96
Table 4.8.7 Summary of AOC 530 Investigations 4.99
Table 4.8.8 Summary of AOC 531 Investigations 4.101
Table 4.8.9 Summary of AOC 538, AOC 539 Investigations 4.102
Table 4.8.10 Summary of AOC 550 Investigations 4.105
Table 4.8.11 Storm Water Effluent Sampling Results, Drainage Basin 23 ..... 4.106
Table 4.8.12 Storm Water Contaminant Migration Pathway Scenario Summary 4.107
Table 4.8.13 Drainage Basin 23 Scenario 1b Catch Basin Evaluation 4.108
Table 4.9.1 Drainage Basin 26 SWMUs/AOCs 4.110
Table 4.9.2 Summary of SWMU 65 Investigations 4.111
Table 4.9.3 Summary of AOC 550 Investigations 4.113
Table 4.9.4 Storm Water Effluent Sampling Results, Drainage Basin 26 ..... 4.114
Table 4.9.5 Storm Water Contaminant Migration Pathway Scenario Summary, DB 26 ... 4.115
Table 4.10.1 Drainage Basin 27 SWMUs/AOCs 4.118
Table 4.10.2 Summary of SWMU 25 Investigations 4.119
Table 4.10.3 Summary of AOC 549 Investigations 4.121
Table 4.10.4 Summary of AOC 559 Investigations 4.123
Table 4.10.5 Summary of AOC 551 and AOC 552 Investigations 4.125
Table 4.10.6 Storm Water Effluent Sampling Results, Drainage Basin 27 ..... 4.126
Table 4.10.7 Storm Water Contaminant Migration Pathway Scenario Summary, DB 27 ... 4.127
Table 4.10.8 Drainage Basin 27 Scenario 1b Catch Basin Evaluation 4.129
Table 4.11.1 Drainage Basin 28 AOCs 4.131
Table 4.11.2 Summary of SWMU 170 and SWMU 171 Investigations 4.132

Table 4.11.3 Summary of AOC 520 Investigations 4.134
Table 4.11.4 Summary of AOC 522 Investigations 4.135
Table 4.11.5 Summary of AOC 523 Investigations 4.136
Table 4.11.6 Summary of AOC 559 Investigations 4.137
Table 4.11.7 Summary of AOC 569, 570, and 578 Investigations 4.140
Table 4.11.8 Storm Water Effluent Sampling Results, Drainage Basin 28 ..... 4.142
Table 4.11.9 Storm Water Contaminant Migration Pathway Scenario Summary, DB 28 ... 4.143
Table 4.12.1 Drainage Basin 30 SWMUs/AOCs 4.146
Table 4.12.2 Summary of Combined SWMU 83 Investigations 4.147
Table 4.12.3 Summary of Combined SWMU 87 Investigations 4.151
Table 4.12.4 Summary of Combined SWMU 170 Investigations 4.154
Table 4.12.5 Summary of AOC 559, AOC 560, and AOC 561 Investigations 4.155
Table 4.12.6 Summary of AOC 562 Investigations 4.158
Table 4.12.7 Summary of AOC 563 Investigations 4.159
Table 4.12.8 Summary of AOC 569, AOC 570, and AOC 578 Investigations 4.161
Table 4.12.9 Summary of AOC 572 Investigations 4.164
Table 4.12.10 Summary of AOC 573 Investigations 4.166
Table 4.12.11 Summary of AOC 576 Investigations 4.168
Table 4.12.12 Summary of AOC 579 Investigations 4.169
Table 4.12.13 Summary of AOC 580 Investigations 4.170
Table 4.12.14 Storm Water Effluent Sampling Results, Drainage Basin 30 ..... 4.172
Table 4.12.15 Storm Water Contaminant Migration Pathway Scenario Summary 4.174
Table 4.12.16 Drainage Basin 30 Scenario 1b Catch basin Evaluation 4.174
Table 4.12.17 Drainage Basin 30 Scenario 1c Catch Basin Evaluation 4.176
Table 4.12.18 Summary of Potential COPCs 4.177
Table 4.13.1 Drainage Basin 30A AOC 567 ..... 4.178
Table 4.13.2 Summary of AOC 567 Investigations 4.179
Table 4.13.3 Storm Water Effluent Sampling Results 4.180
Table 4.13.4 Storm Water Contaminant Migration Pathway Scenario Summary DB 30A 4.181
Table 4.13.5 Drainage Basin 30A Scenario 1b Catch Basin Evaluation 4.182
Table 4.14.1 Drainage Basin 31 AOCs 4.184
Table 4.14.2 Summary of AOC 566 Investigations 4.185
Table 4.14.3 Summary of AOC 567 Investigations 4.186
Table 4.14.4 Storm Water Effluent Sampling Results, Drainage Basin 31 ..... 4.187
Table 4.14.5 Storm Water Contaminant Migration Pathway Scenario Summary, DB 31 ... 4.188
Table 4.15.1 Drainage Basin 32 SWMUs/AOCs 4.191
Table 4.15.2 Summary of SWMU 145 Investigations 4.192
Table 4.15.3 Summary of SWMU 188 Investigations 4.194
Table 4.15.4 Summary of AOC 576 Investigations 4.195
Table 4.15.5 Summary of AOC 583 Investigations 4.196
Table 4.15.6 Storm Water Effluent Sampling Results, Drainage Basin 32 ..... 4.198
Table 4.15.7 Storm Water Contaminant Migration Pathway Scenario Summary, DB 32 ... 4.199
Table 4.16.1 Drainage Basin 33 SWMUs/AOCs 4.200
Table 4.16.2 Summary of SWMU97 Investigations 4.201
Table 4.16.3 Summary of AOC 586 Investigations 4.202

Table 4.16.4 Storm Water Effluent Sampling Results, Drainage Basin 33 ..... 4.203
Table 4.16.5 Storm Water Contaminant Migration Pathway Scenario Summary, DB 33 ... 4.204
Table 4.16.6 Drainage Basin 33 Scenario 1b Catch Basin Evaluation 4.205
Table 4.17.1 Drainage Basin 34 SWMUs/AOCs 4.207
Table 4.17.2 Summary of SWMU 100 Investigations 4.208
Table 4.17.3 Summary of SWMU 102 Investigations 4.210
Table 4.17.4 Summary of SWMU 109 Investigations 4.211
Table 4.17.5 Summary of AOC 607 Investigations 4.214
Table 4.17.6 Summary of AOC 609 Investigations 4.218
Table 4.17.7 Storm Water Effluent Sampling Results, Drainage Basin 34 ..... 4.220
Table 4.17.8 Storm Water Contaminant Migration Pathway Scenario Summary 4.220
Table 4.18.1 Drainage Basin 35 SWMUs/AOCs 4.223
Table 4.18.2 Summary of SWMU 102 Investigations 4.224
Table 4.18.3 Summary of AOC 590 Investigations 4.226
Table 4.18.4 Summary of AOC 596 Investigations 4.227
Table 4.18.5 Summary of AOC 613 Investigations 4.228
Table 4.18.6 Storm Water Effluent Sampling Results, Drainage Basin 35 ..... 4.231
Table 4.18.7 Storm Water Contaminant Migration Pathway Scenario Summary, DB 35 ... 4.231
Table 4.19.1 Drainage Basin 36 SWMUs/AOCs 4.233
Table 4.19.2 Summary of AOC 596 Investigations 4.234
Table 4.19.3 Summary of AOC 598 Investigations 4.236
Table 4.19.4 Storm Water Effluent Sampling Results, Drainage Basin 36 ..... 4.237
Table 4.19.5 Storm Water Contaminant Migration Pathway Scenario Summary, DB 36 ... 4.238
Table 4.20.1 Drainage Basin 37 SWMUs/AOCs 4.239
Table 4.20.2 Summary of SWMU 3 ..... 4.241
Table 4.20.3 Summary of SWMU 24 ..... 4.243
Table 4.20.4 Summary of AOC 607 Investigations 4.245
Table 4.20.5 Summary of AOC 609 Investigations 4.250
Table 4.20.6 Summary of AOC 611 Investigations 4.251
Table 4.20.7 Summary of AOC 613 Investigations 4.253
Table 4.20.8 Storm Water Effluent Sampling Results, Drainage Basin 37 ..... 4.255
Table 4.20.9 Storm Water Contaminant Migration Pathway Scenario Summary, DB 37 ... 4.256
Table 4.20.10 Drainage Basin 37 Scenario 1b Catch Basin Evaluation 4.258
Table 4.20.11 Summary of Potential COPCs 4.259
Table 4.21.1 Drainage Basin 38 AOCs 4.260
Table 4.21.2 Summary of SWMU 4, AOC 619 Investigations 4.261
Table 4.21.3 Summary of AOC 602 Investigations 4.263
Table 4.21.4 Summary of AOC 603 Investigations 4.265
Table 4.21.5 Summary of AOC 616 Investigations 4.267
Table 4.21.6 Summary of AOC 617 Investigations 4.268
Table 4.21.7 Storm Water Effluent Sampling Results, Drainage Basin 38 ..... 4.269
Table 4.21.8 Storm Water Contaminant Migration Pathway Scenario Summary, DB 38 ... 4.270
Table 4.22.1 Drainage Basin 39 SWMUs/AOCs 4.273
Table 4.22.2 Summary of SWMU 106/AOC 603 Investigations 4.274
Table 4.22.3 Storm Water Effluent Sampling Results, Drainage Basin 39 ..... 4.276
Table 4.22.4 Storm Water Contaminant Migration Pathway Scenario Summary, DB 39 ... 4.276

Table 4.23.1 Drainage Basin 40 SWMUs/AOCs 4.278
Table 4.23.2 Summary of SWMU 106/AOC 603 Investigations 4.279
Table 4.23.3 Summary of AOC 602 Investigations 4.281
Table 4.23.4 Storm Water Effluent Sampling Results, Drainage Basin 40 ..... 4.282
Table 4.23.5 Storm Water Contaminant Migration Pathway Scenario Summary, DB 40 ... 4.282
Table 4.24.1 Drainage Basin 41 SWMUs/AOCs 4.284
Table 4.24.2 Summary of SWMU 5, SWMU 18, AOC 605 Investigations 4.286
Table 4.24.3 Summary of AOC 604 Investigations 4.289
Table 4.24.4 Summary of AOC 620 Investigations 4.290
Table 4.24.5 Storm Water Effluent Sampling Results, Drainage Basin 41 ..... 4.291
Table 4.24.6 Storm Water Contaminant Migration Pathway Scenario Summary, DB 41 ... 4.292
Table 4.24.7 Drainage 41 Scenario 1b Catch Basin Evaluation 4.294
Table 4.24.8 Summary of Potential COPCs 4.295
Table 4.25.1 Storm Water Effluent Sampling Results, Drainage Basin 42A 4.296
Table 4.25.2 Storm Water Contaminant Migration Pathway Scenario Summary DB 42A 4.297
Table 4.26.1 Drainage Basin 43 SWMUs/AOCs 4.300
Table 4.26.2 Summary of SWMU 4/AOC 619 Investigations 4.301
Table 4.26.3 Summary of SWMU 36 and AOC 620 Investigations 4.303
Table 4.26.4 Summary of SWMUs 6, 7, and AOC 635 Investigations 4.306
Table 4.26.5 Summary of AOC 628 Investigations 4.308
Table 4.26.6 Summary of AOC 633 Investigations 4.310
Table 4.26.7 Storm Water Effluent Sampling Results, Drainage Basin 43 ..... 4.311
Table 4.26.8 Storm Water Contaminant Migration Pathway Scenario Summary, DB 43 ... 4.313
Table 4.27.1 Drainage Basin 43A/43B SWMUs/AOCs 4.315
Table 4.27.2 Summary of SWMU 120 Investigations 4.316
Table 4.27.3 Summary of AOC 638 Investigations 4.318
Table 4.27.4 Storm Water Effluent Sampling Results, Drainage Basin 43A 4.320
Table 4.27.5 Storm Water Contaminant Migration Pathway Scenario Summary DB 43A 4.321
Table 4.28.1 Drainage Basin 44 SWMUs/AOCs 4.323
Table 4.28.2 Summary of SMUW 8, AOC 636 Investigations 4.324
Table 4.28.3 Summary of AOC 638 Investigations 4.327
Table 4.28.4 Storm Water Effluent Sampling Results, Drainage Basin 44 ..... 4.328
Table 4.29.1 Drainage Basin 45 SWMUs/AOCs 4.330
Table 4.29.2 Summary of SWMU 8, AOC 636 Investigations 4.331
Table 4.29.3 Summary of AOC 642 Investigations 4.333
Table 4.29.4 Summary of AOC 45 Investigations 4.335
Table 4.29.5 Storm Water Effluent Sampling Results, Drainage Basin 45 ..... 4.337
Table 4.29.6 Storm Water Contaminant Migration Pathway Scenario Summary, DB 45 ... 4.338
Table 4.29.7 Drainage Basin 45 Scenario 1b Catch Basin Evaluations 4.339
Table 4.29.8 Summary of Potential COPCs 4.340
Table 4.30.1 Drainage Basin 47 SWMUs/AOCs 4.341
Table 4.30.2 Summary of SWMU 13/AOC 659 Investigations 4.343
Table 4.30.3 Summary of SWMU 17 Investigations 4.345
Table 4.30.4 Summary of AOC 672/673 Investigations 4.348

Table 4.30.5 Summary of AOC 653 Investigations 4.350
Table 4.30.6 Summary of AOC 655/656 Investigations 4.352
Table 4.30.7 Summary of AOC 671 Investigations 4.356
Table 4.30.8 Summary of OIA G07/G38 Investigations 4.357
Table 4.30.9 Storm Water Effluent Sampling Results, Drainage Basin 47 ..... 4.359
Table 4.30.10 Storm Water Contaminant Migration Pathway Scenario Summary, DB 47 ... 4.362
Table 4.30.11 Drainage Basin 47 Scenario 1b Catch Basin Evaluations 4.364
Table 4.30.12 Summary of Potential COPCs 4.365
Table 4.31.1 Drainage Basin 47A SWMUs/AOCs 4.366
Table 4.31.2 Summary of SWMU 177/RTC Investigations 4.367
Table 4.31.3 Storm Water Effluent Sampling Results, Drainage Basin 47A 4.369
Table 4.31.4 Storm Water Contaminant Migration Pathway Scenario Summary DB 47A 4.369
Table 4.32.1 Drainage Basin 47B SWMUs/AOCs 4.372
Table 4.32.2 Summary of SWMU 37 Investigations 4.373
Table 4.32.3 Storm Water Effluent Sampling Results, Drainage Basin 47B 4.374
Table 4.32.4 Storm Water Contaminant Migration Pathway Scenario Summary DB 47B 4.375
Table 4.33.1 Drainage Basin 48 SWMUs/AOCs 4.377
Table 4.33.2 Summary of SWMU 13 Investigations 4.378
Table 4.33.3 Summary of AOC 663 and SWMU 136 Investigations 4.380
Table 4.33.4 Summary of SWMU 178 Investigations 4.382
Table 4.33.5 Summary of AOC 660 Investigations 4.384
Table 4.33.6 Summary of AOC 665 Investigations 4.385
Table 4.33.7 Summary of Combined 678/679 Investigations 4.387
Table 4.33.8 Summary of OIA G80 Investigations 4.389
Table 4.33.9 Summary of SWMU 177/RTC Investigations 4.391
Table 4.33.10 Storm Water Effluent Sampling Results, Drainage Basin 48 ..... 4.392
Table 4.33.11 Storm Water Contaminant Migration Pathway Scenario Summary, DB 48 ... 4.395
Table 4.34.1 Drainage Basins 48A to 48G SWMUs/AOCs 4.397
Table 4.34.2 Summary of AOCs 675/676/677 Investigations 4.398
Table 4.34.3 Summary of AOCs 678/679 Investigations 4.400
Table 4.34.4 Summary of AOC 680 Investigations 4.402
Table 4.34.5 Storm Water Effluent Sampling Results, Drainage Basins 48A to 48G 4.403
Table 4.34.6 Storm Water Contaminant Migration Pathway Scenario Summary, 48A to 48G 4.407
Table 4.34.7 Drainage Basin 48A to 48G Scenario 1b Catch Basin Evaluation 4.408
Table 4.35.1 Drainage Basin 48H SWMUs/AOCs 4.410
Table 4.35.2 Summary of AOC 681 Investigations 4.412
Table 4.35.3 Storm Water Effluent Sampling Results, Drainage Basin 48H 4.413
Table 4.35.4 Storm Water Contaminant Migration Pathway Scenario Summary DB 48H 4.414
Table 4.36.1 Drainage Basin 49 SWMUs/AOCs 4.417
Table 4.36.2 Summary of AOC 666 Investigations 4.419
Table 4.36.3 Summary of AOC 680 Investigations 4.421
Table 4.36.4 Summary of OIA G80 Investigations 4.423

Table 4.36.5 Storm Water Effluent Sampling Results, Drainage Basin 49 ..... 4.424
Table 4.36.6 Storm Water Contaminant Migration Pathway Scenario Summary, DB 49 ... 4.425
Table 4.37.1 Drainage Basin 51 SWMUs/AOCs 4.428
Table 4.37.2 Summary of SWMU 17 Investigations 4.429
Table 4.37.3 Summary of AOC 667/SWMU 138 Investigations 4.433
Table 4.37.4 Storm Water Effluent Sampling Results, Drainage Basin 51 ..... 4.435
Table 4.37.5 Storm Water Contaminant Migration Pathway Scenario Summary, DB 51 ... 4.436
Table 4.37.6 Drainage Basin 51 Scenario 1b Catch Basin Evaluations 4.438
Table 4.37.7 Summary of Potential COPCs 4.439
Table 4.38.1 Drainage Basin 51C SWMUs/AOCs 4.440
Table 4.38.2 Summary of AOC 687/SWMU 16 Investigations 4.441
Table 4.38.3 Storm Water Effluent Sampling Results, Drainage Basin 51C 4.442
Table 4.38.4 Storm Water Contaminant Migration Pathway Scenario Summary, DB 51C 4.443
Table 4.39.1 Drainage Basin 53 SWMUs/AOCs 4.446
Table 4.39.2 Summary of AOC 607 Investigations 4.447
Table 4.39.3 Summary of AOC 609 Investigations 4.451
Table 4.39.4 Summary of AOC 611 Investigations 4.453
Table 4.39.5 Storm Water Effluent Sampling Results, Drainage Basin 53 ..... 4.454
Table 4.39.6 Storm Water Contaminant Migration Pathway Scenario Summary, DB 53 ... 4.455
Table 4.40.1 Clouter Island SWMUs/AOCs 4.459
Table 4.40.2 Summary of AOCs 694/694 Investigations 4.460
Table 4.40.3 Summary of AOCs 695 Investigations 4.462
Table 5.1 United States Coast Guard Recorded Spills/Releases into the Charleston Harbor 5.1
Table 5.2 CNC Related Spills/Releases, Cooper River 1982-1994 ..... 5.69
Table 6.1 Potential Storm Water COPCs for the Cooper River 6.1

List of Appendices

Appendix A Chains of Custody, Analytical Data, Data Validation Reports
Appendix B Incident Reports and Website Instructions

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

The following abbreviations, acronyms, and units of measurement are used in this report.

°C	Degrees Celsius
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
µmho/cm	Micro Siemens per Centimeter
%D	Percent Difference
%RSD	Percent Relative Standard Deviation
AA	Atomic Absorption
AF	Air Force
AOC	Area of Concern
AST	Aboveground Storage Tank
ATM	Applied Technology and Management, Inc.
BCT	Base Closure Team
BEHP	bis(2-ethylhexyl)phthalate
BEQ	benzo(a)pyrene Equivalent Quotient
BKG	Background Concentration
BMP	Best Management Practices
BOD	Biochemical Oxygen Demand
BTEX	Benzene, Toluene, Ethyl-benzene, Xylene
CAS	Chemical Abstract Service
CCC	Calibration Check Compound
CEC	Cation Exchange Capacity
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CH4	Methane
CIA	Controlled Industrial Area
CLP	Contract Laboratory Program
CMS	Corrective Measures Study
CNC	Charleston Naval Complex
CNSY	Charleston Naval Shipyard
CO2	Carbon Dioxide
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CSI	Confirmatory Sampling Investigation
CWP	Center for Watershed Protection
DB	Drainage Basin
DDD	Dichlorodiphenyldichloroethane
DDE	1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene
DDT	Dichloro-Diphenyl-Trichlorethane

DET	Navy Environmental Detachment
DMA	Dredge Material Area
DNAPL	Dense Non-aqueous Phase Liquid
DO	Dissolved Oxygen
DQO	Data Quality Objective
DRMO	Defense Reutilization Marketing Office
DRO	Diesel Range Organics
E/A&H	EnSafe/Allen and Hoshall
EBS	Environmental Baseline Survey
EBSL	Environmental Baseline Survey for Lease
ECT	Environmental Consulting and Technology, Inc.
EMC	Event Mean Concentration
EPA	Environmental Protection Agency
FBM	Fleet Ballistic Missile
FDS	Fuel Distribution System
ft	Feet
g	Gram
GIS	Geographic Information System
GRO	Gasoline Range Organics
GW	Groundwater
ICAP	Inductively Coupled Argon Plasma
ICP	Inductively Coupled Plasma
IM	Interim Measure
IMS	Interim Stabilization Measure
LCS	Laboratory Control Sample
LF	Linear Feet
LNAPL	Light Non-aqueous Phase Liquid
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
mg/kg	Milligrams Per Kilogram
mg/L	Milligrams Per Liter
mi^2	Square Miles
mL	Milliliter
MNA	Monitored Natural Attenuation
MSL	Mean Sea Level
m^3/sec	cubic meters per second
NA	Not Applicable
ND	Not Detected
NEESA	Naval Energy and Environmental Support Activity

NFA	No Further Action
ng	Nanogram
NH_3	Ammonia
NL	No Listed SWMU/AOC
NL	Not Listed
NOAA	National Oceanic and Atmospheric Administration
NO_2	Nitrite
NO_3	Nitrate
NPDES	National Pollutant Discharge Elimination System
NR	Not Reported
NR	Not Required
NRC	National Response Center
NRCS	Natural Resources Conservation Service
NTU	Nephelometric Turbidity Units
NWS	Naval Weapons Station
OIA	Other Impacted Areas
OP	Organophosphorous
OSWER	Office of Solid Waste and Emergency Response
OVA	Organic Vapor Analysis
OWS	Oil/Water Separator
PAH	Poly Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PE	Performance Evaluation
POL	Petroleum, Oil, and Lubricant
PPM	Parts Per Million
PPT	Parts Per Thousand
PQL	Practical Quantitation Limit
PST	Petroleum Storage Tank
QA/QC	Quality Assurance/Quality Control
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RF	Response Factor
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RGO	Remedial Goal Option
RRF	Relative Response Factor
RTC	Reserve Training Center
SAA	Satellite Accumulation Area
SB	Surface Boring
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources

SCE&G	South Carolina Electric and Gas
SCHWMR	South Carolina Hazardous Waste Management Regulations
SCL	Seaboard Coast Line
SCPSA	South Carolina Public Service Authority
SDG	Sample Delivery Group
SGC	Soil Gas Confirmation
SIMA	Shore Intermediate Maintenance Activity
SLERA	Screening-Level Ecological Risk Assessment
SPA	State Ports Authority
SPCC	System Performance Calibration Compounds
SPORTENVDETCHASN	Environmental Detachment
SPLP	Synthetic Precipitation Leaching Procedure
SSV	Sediment Screening Value
STDEV	Standard Deviation
SU	Standard Unit
SUPSHIP	Supervisor of Shipbuilding, Conversion and Repair
SVOC	Semi-volatile Organic Compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCLP	Toxicity Characteristic Leachate Procedure
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids
UCL	Upper Confidence Limit
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USN	United States Navy
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WTM	Watershed Treatment Model
WWTS	Wastewater Treatment System

EXECUTIVE SUMMARY

The environmental investigation and remediation activities at Charleston Naval Complex (CNC) are required by the Hazardous and Solid Waste Amendments portion of the Resource, Conservation and Recovery Act (RCRA), Part B permit. For management purposes, CNC has been geographically divided into 12 investigative "zones" identified as A through L. Zone J consists of portions of the Cooper River, Shipyard Creek, Noisette Creek, and associated marsh areas. Characterizations include evaluations of storm water discharge, sediments below the mean high water mark, and the water bodies surrounding CNC. The main objective of the Zone J RCRA Facility Investigation (RFI) is to assess impacts from CNC-related discharges to receptors within Zone J.

The Navy completed preliminary sampling of the water bodies in September 1997, using the protocols and methods outlined in the *Final Comprehensive Sampling and Analysis Plan* (EnSafe/Allen & Hoshall (E/A&H) July 1996) and the *Zone J RFI Work Plan* (E/A&H December 1996). In a December 1997 technical memorandum entitled *Preliminary Results of Zone J Sampling* (EnSafe), the Navy presented the investigative approach, deviations from the Zone J work plan, applied sampling protocols, and presented analytical results of the Zone J sampling. Numerous zone-specific investigations of upland areas of concern/solid waste management units (AOCs/SWMUs) were still ongoing when the 1997 Zone J sampling was completed. Therefore, correlations between the constituents detected in Zone J and potential CNC sources were not attempted. However, the 1997 technical memorandum did present a preliminary list of chemicals of potential concern (COPCs) in Zone J sediments and surface waters, and a map of contaminant distributions.

EnSafe submitted the *Zone J Draft RFI Report - Part One* on April 24, 2000 to the South Carolina Department of Health and Environmental Control (SCDHEC), the South Carolina Department of Natural Resources (SCDNR), the National Oceanic and Atmospheric Administration (NOAA), the United States Environmental Protection Agency (USEPA), and the United States Fish and Wildlife Service (USFWS) for their review and comment. The Part One report presented a screening-level ecological risk assessment (SLERA) using the preliminary results of Zone J sampling and the protocols outlined in the USEPA1997 guidance document for Superfund, Process for Designing and

Conducting Ecological Risk Assessments.

Comments from reviewing agencies on the Part One report addressed general approach, document preparation, approach in evaluating lines of evidence for eliminating COPCs from further investigation, more in-depth evaluation of linkages between CNC and Zone J and a clearer determination of reference concentrations.

EnSafe and the Navy presented the migration pathway evaluation process to the Base Closure Team (BCT) in September 2000, along with checklists desired to yield a more definitive assessment of potential contaminant migration pathways and the scope of work required to complete the next phase of the Zone J RFI. EnSafe and the Navy concluded that CNC storm water effluent data were required to produce a reasonably definitive evaluation of the migration pathway scenarios, particularly for contaminant transport via storm water drainage pipelines and effluent.

At the May 2001 BCT project team meeting, EnSafe presented the conceptual approach for collecting effluent samples from CNC and reference samples from non-point-source locations offsite. The approach was agreed upon by the project team, which decided that a scoping package would be presented to the BCT project team prior to submittal of the Point of Entry Effluent Sampling Work Plan to incorporate comments from the SCDHEC. The scoping package was presented at the August 2001 project team meeting where a consensus was reached that a number of reference locations should also come from areas on base that were not influenced by an AOC/SWMU, if possible.

Evaluation of CNC storm water effluent is an interim phase of the Zone J RFI. The investigation will continue until sufficient data is obtained to determine whether COPCs are present from the other migration pathways and if the COPCs can be attributed to a Navy source. Data will be used to characterize the associated impact to the receiving waters and potential receptors.

This report focuses on the CNC outfalls associated with the Cooper River. Storm water effluent sample detections were evaluated for COPCs and compared with CNC site data to evaluate upland

source linkages for Scenario 1 (Transport to Zone J via Storm Water Drainage Pipeline), which describes a release from a SWMU or AOC resulting in either:

1a) Waste being introduced directly into a storm sewer catch basin, and migrating via the storm sewer pipeline to Zone J;

1b) Storm water runoff transporting contaminated media into a storm sewer catch basin, and migrating via the storm sewer pipeline to Zone J;

1c) Contaminated groundwater being intercepted by and entering a low-integrity storm sewer pipeline and migrating via the storm sewer pipeline to Zone J; or

1d) Waste discharging directly to Zone J via sanitary/storm sewer cross connects.

Much of the CNC storm water system is influenced by tidal activity and is inundated by surface water to some degree during high tide. Storm water effluent was collected from outfalls that discharge into the Cooper River during periods of precipitation that occurred at low tide to prevent inclusion of surface water in the sample. The storm water drainage basins (DB) sampled for this report are:

DB1	DB33	DB47B
DB2	DB34	DB48
DB3	DB35	DB48A/48G
DB18	DB36	DB48H
DB20	DB37	DB49
DB22	DB38	DB51
DB23	DB39	DB51C
DB26	DB40	DB53
DB27	DB41	
DB28	DB42A	
DB30	DB43B	
DB30A	DB44	
DB30C	DB45	
DB31	DB47	
DB32	DB47A	

Storm water effluent sample detections were compared against storm water effluent reference and screening criteria, upland surface soil detections, groundwater detections, and environmental incident and sewer cross-connect reports in determining COPCs for further evaluation and linkages to CNC sites. The following lists storm water drainage basins that warrant further investigation of the specified COPCs and linkages:

Drainage Basin	Potential Storm Water COPCs	Upland Linkage
DB 3	Lead	Soil
	Mercury	Soil and Groundwater
	Vanadium	Soil
DB 20	Aluminum	Groundwater
	Bis(2-Ethylhexyl)phthalate	Soil
	Iron	Soil and Groundwater
	Lead	Soil
	Zinc	Soil
DB 30	Copper	Soil and Groundwater
	Nickel	Soil and Groundwater
DB 37	Benzo(g,h,i)perylene	Soil
DB 41	Aluminum	Soil
	Iron	Soil
DB 45	Barium	Soil
	Beryllium	Soil
	Cobalt	Soil
	Lead	Soil
	Nickel	Soil
	Vanadium	Soil
DB 47	Bis(2-Ethylhexyl)phthalate	Soil
DB 51	Bis(2-Ethylhexyl)phthalate	Release and Soil
	Copper	Soil

Hydrodynamic evaluation of the Cooper River was performed as part of this study to determine transport of CNC and non-CNC contaminants in these water bodies. This evaluation has determined that pollutants released into the water bodies are transported both up and down stream with the flood and ebb tides, although there is a net downstream component towards the ocean. Hydrodynamics of the Charleston Harbor Estuary system are dominated by the tidal currents generated by tidal propagation. Tidal flow measurement studies were conducted in 1996 for the Charleston Harbor Estuary and tributaries. Tidal flow (averaged over the tidal cycle) in the Cooper River was estimated to be 18 times the freshwater flow. Water diversion projects and dredging operations performed in the estuary have affected hydrodynamics in the Cooper River and Charleston Harbor Estuary. Freshwater diversion projects have resulted in changes to density stratification in the estuary and sediment load, while dredging operations have affected river and harbor bathymetric contours which affect the complex tidal current patterns that are responsive to tide range, shoreline geometry, river cross-sectional area, bottom roughness, and freshwater discharges. Tidal currents in the Charleston Harbor Estuary were found to have significant spatial variability. Therefore, the pathway and fate of a pollutant spill in the estuary can be highly variable, depending on location of the spill, time history of the spill, and tidal currents after the spill. Sediment originating from the area adjacent to the Charleston Harbor Estuary can be transported over a large area in the form of either suspended load or bed load, and can be deposited or accumulated in various parts of the estuary because of the complex tidal current and circulation pattern in the Charleston Harbor Estuary

Runoff analysis performed on CNC determined that total runoff volume from CNC and adjacent offsite area for a 24-hour, 25-year storm is 497 acre-ft, which is approximately 0.5 percent of the total tidal flow volume in the Cooper River within one tidal cycle (12.4 hours). The total runoff volume for a 24-hour, 100-year storm is 658 acre-ft is about 0.6 percent of the Cooper River tidal flow volume within one tidal cycle.

1.0 INTRODUCTION

The purpose of the Zone J RFI is to assess Navy-related impacts to the water bodies adjacent to the CNC as part of the overall basewide assessment. Zone J, which consists of portions of the Cooper River, Shipyard Creek, and Noisette Creek and their associated marsh areas, is one of CNC's 12 interdependent RFI zones. Zone J characterizations include evaluations of storm water discharge, sediments beyond the mean high water mark and the water bodies surrounding CNC. It is also the only zone that is entirely within an estuarine system and with only rivers, creeks, and marshes, the investigated components are more ecological than industrial. As such, standard industrial site investigative protocols (monitoring well and soil boring installation, etc.) are inappropriate, necessitating the use of a variety of preliminary investigative techniques.

To date, the Zone J RFI techniques have included unbiased offshore sampling to assess the nature and extent of sediment contamination, screening-level ecological risk assessments to determine potential adverse effects of detected contaminants to aquatic receptors, and conceptual site models to define potential routes of exposure. These approaches have not yielded a complete and comprehensive evaluation of CNC impacts to the Zone J water bodies since such a broad evaluation requires a thorough analysis of contaminant migration pathways between suspected CNC sources and Zone J. Site-specific analytical data collected from AOCs/SWMUs during RFI and Corrective Measures Study (CMS) activities are being evaluated and screened against ecological screening values to complete migration pathway evaluations and determine if a possible linkage exists to the contribution of contamination to Zone J water bodies. This addendum report evaluates the storm water migration pathways and identifies COPCs, hydrodynamics of the Cooper River as part of the Zone J estuary system, and data gaps that will be addressed in the future.

Section 2 describes transportation mechanisms of contaminants in the Cooper River. Preliminary hydrodynamic modeling will also aid in the predictions of contaminant fate and transport entering Zone J water bodies. Section 3 details the data quality objectives (DQOs) and the appropriate guidance for the RFI at CNC. Section 4 includes discussions on CNC drainage basin evaluations for Cooper River. Evaluations will include descriptions of drainage basins and associated AOCs/SWMUs, previous site investigations, storm water effluent data evaluation, COPCs and

upland terrestrial unit source identification, and possible data gaps. Section 5 describes historical releases of contaminants into the Cooper River. Section 6 summarizes the conclusion of each drainage basin summary relating to storm water evaluations, and Section 7 is a compilation of references.

Unique to this report is the creation of a website that will contain project documents and figures, milestones, schedules, and an interactive information system that includes historical analytical data and geological features of the CNC. The website was created to provide access to data and documents on a real-time basis with the ability to review from a remote access. Instructions on how to utilize the website information system are included in Appendix B. Initial login access will be established by contacting Charlie Vernoy, Task Order Manager, at 843-884-0029 or at cvernoy@ensafe.com. System Coordinator is Zac Odom and can be reached by email at zodom@ensafe.com.

2.0 HYDRODYNAMICS OF THE COOPER RIVER AND CHARLESTON HARBOR ESTUARY

The Charleston Harbor Estuary is a complex tidal estuarine system that is comprised of the Charleston Harbor, Cooper River, Ashley River, Wando River, and other small tributaries. It encompasses more than 100 square miles (mi^2) of coastal marshlands and open water habitat. The hydrodynamics of the Charleston Harbor Estuary system are mostly dominated by the tidal currents generated by the tidal propagation. Although the freshwater inflows play a secondary role in the hydrodynamics in the estuary, it has an important effect on water quality, salinity distribution, and aquatic habitat in the system. The freshwater flow also has important effects on long-term transport and flushing of the pollutants.

2.1 Freshwater Inflow

Cooper River is the largest freshwater source of the Charleston Harbor Estuary and has experienced the greatest anthropogenic impact compared to other tributaries. In its original state, the Cooper River was a small tidal river with an average freshwater flow rate of 70 cubic feet per second (cfs) (2 cubic meters per second [m^3/sec]) (Conrads, *et. al.,* 1997); the combined discharge of the Ashley, Cooper, and Wando Rivers was only 353 cfs (10 m^3/sec). (U.S. Army Corps of Engineers [USACE], 1966).

In 1942, the South Carolina Public Service Authority (SCPSA) completed the first diversion project of the Cooper River, which was to provide hydroelectric power to the Santee-Cooper area. This project involved construction of the Wilson Dam on the Santee River to form Lake Marion, construction of the Pinopolis Dam at the headwaters of the Cooper River to form Lake Moultrie, and construction of a 7.5-mile canal between the two lakes through which approximately 88 percent of the freshwater flow from the Santee River was directed to the Cooper River (Little, 1974; Kjerfve, 1976; Kjerfve and Magill, 1990; USACE, 1975). The diversion project increased the Cooper River drainage area to 15,700 mi^2 (Neiheisel and Weaver, 1967) and consequently increased the average freshwater flow into the Cooper River to approximately 15,600 cfs (442 m^3/sec) (Kjerfve, 1976). This reduced mean salinity in the harbor from 30.0 to 16.8 parts per thousand (ppt) (Zelter, 1953). The freshwater diversion also resulted in greater density stratification in the estuary. In addition, the increased sediment load to the Cooper River, associated

with the increased freshwater flow, caused significant sedimentation in the Cooper River. As a result, significant dredging was required to maintain the navigation channel.

To alleviate the shoaling problems attributed to the 1942 diversion project and still maintain the potential for hydroelectric power generation, the USACE completed the Cooper River Rediversion Project in August 1985. This project redirected approximately 70 percent of the water flow from the Cooper River back into the Santee River through a new 11.5-mile canal in the vicinity of St. Stephens, South Carolina. Since rediversion, the monthly mean flow into the Cooper River has been reduced to approximately 4,500 cfs. According to Cooney *et al.* (1996), the mean annual flows from Pinopolis Dam to the West Branch Cooper River were 5,470 and 5,270 cfs in 1993 and 1994, respectively. The USACE estimated a reduction in shoaling by 40 to 70 percent after the rediversion project was complete.

2.2 Tides

According to the tide tables published by NOAA (2002a), the mean tidal range at Fort Sumter near the Charleston Harbor entrance is 5.09 feet (ft) and the spring tide range is 5.90 ft. Table 2.1 presents the tide ranges and phases at various locations in Charleston Harbor and the Cooper River. It indicates that the tide range is amplified when the tidal wave propagates from the harbor entrance up the Cooper River. The tide range reaches its maximum near the north entrance of the Clouter Creek, about 3.3 miles north of the Noisette Creek, where the mean and spring tide ranges are 5.48 and 6.36 feet (ft), respectively. Further upstream from this location, the tide range is gradually dampened. The mean and spring tide ranges in the West Branch Cooper River at Pimlico are 1.70 and 1.97 ft, respectively. The tidal phase lag between Fort Sumter and the north entrance of Clouter Creek at low tide is within 20 minutes. The phase lag at Pimlico is 3.9 hours.

Table 2.1 Tidal Ranges and Phases in Charleston Harbor/Cooper River

Station	Mean Tide Range (ft)	Spring Tide Range (ft)	Phase Lag (hours)
Fort Sumter	5.09	5.90	-0.02
Charleston (Customhouse Wharf)	5.27	6.11	0.00
Shipyard Creek	5.30	6.10	0.33
Cooper River at Clouter Creek, north entrance	5.40	6.26	0.32
Cooper River at Clouter Creek, south entrance	5.48	6.36	0.55
Cooper River at Snow Point	5.36	6.22	0.75
Cooper River at General Dynamics Pier	4.37	5.07	1.42
Cooper River at Dupon, Dean Hall	3.43	3.98	2.12
Cooper River at Old Rice Mill, West Branch	2.60	3.02	2.93
Cooper River at Pimlico, West Branch	1.70	1.97	3.90

Note: Phase lag is relative to the tide phase at Customhouse.

Source: NOAA, 2002a.

Table 2.2 presents the tidal ranges and phases in the Ashley River. The mean and spring tide ranges at South Ashley Bridge are 5.34 and 6.19 ft, respectively. The tide range is amplified when tide propagates up the river due to the effects of the standing wave, or wave reflection off the upstream boundary. The mean and spring tide ranges at Greggs Landing are 6.06 and 7.03 ft, respectively, where the phase lag is 1.70 hours behind that at the Customhouse Wharf.

Table 2.3 presents the tidal ranges and phases in the Wando River. The mean and spring tide ranges at Hobcaw Point are 5.76 and 6.68 ft, respectively. Similar to the Cooper River and Ashley River, the tide range for the Wando River is amplified while propagating upstream. It reaches the maximum near the Big Paradise Island where the mean and spring tide ranges are 6.54 and 7.59 ft, respectively, and the phase lag is 1.4 hours behind that at the Customhouse Wharf.

2.3 Tidal Currents

The tidal current pattern in the Charleston Harbor Estuary is quite complex and is affected by tide range, bathymetry, shoreline geometry, river cross-sectional area, bottom roughness, and freshwater discharges. For demonstration purposes, Figures 2-1 through 2-8 depict the current

pattern in the estuary at 1.5-hour intervals throughout a complete tidal cycle. The current vectors were produced by Tides & Currents, a commercial software created by Nobeltec Corporation (2002).

Table 2.4 presents the average peak flood and ebb current speeds and phase lags at selected locations in Charleston Harbor and the Cooper River as reported by NOAA (2002b). It shows that the current pattern is much more complex than the distribution of tidal ranges and has significant spatial variability, especially in the harbor. In general, the peak ebb current speed is greater than the peak flood current speed, except at the Hog Island Channel located northwest of the Crab Bank, the Folly Island Channel north of Ft. Johnson at Middle Ground, and the Cove between Crab Bank and Sullivans Island. The tidal current information also shows that there is a net counter-clockwise circulation in the harbor. The counter-clockwise residual current is depicted by a stronger ebb current and weaker flood current in the western and southern portion of the harbor (South Channel, Custom House Reach, and Town Creek).

In contrast, a stronger flood current and weaker ebb current is observed in the eastern portion of the harbor (Folly Reach, Shutes Reach, Horse Reach, Hog Island Reach, and east of Drum Island). Therefore the ebb current is much stronger than the flood current in the western portion of the harbor (e.g., the ebb current speed is more than three times of the flood current speed in Town Creek), and the difference between flood and ebb current speeds is reduced in the eastern portion of the harbor. The strongest flood current occurs at Horse Reach (1.4 knots), and the strongest ebb current occurs at Town Creek above the bridge (2.5 knots) and at the South Channel 0.8 mile east-northeast of Ft. Johnson (2.6 knots).

The weakest flood current occurs at Drum Island Reach at Buoy "45" (0.6 knots) and near Shipyard Creek entrance (0.5 knots). The weakest ebb current occurs at Hog Island Channel and the Cove near Crab Bank (0.8 and 0.9 knots, respectively). Similarly, Tables 2.5 and 2.6 present the average peak flood/ebb tidal currents in Ashley River and Wando River, respectively.

Table 2.2 Tidal Ranges and Phases in Ashley River

Station	Mean Tide Range (ft)	Spring Tide Range (ft)	Phase Lag (hours)
Fort Sumter	5.09	5.90	-0.02
Ashley River at South Ashley Bridge	5.34	6.19	0.12
Ashley River at Duck Island	5.60	6.50	0.28
Ashley River at Cosgrove Bridge	5.62	6.52	0.30
Ashley River at Drayton, Bee's Ferry	5.76	6.68	0.65
Ashley River at Magnolia Gardens	5.79	6.72	0.90
Ashley River at Greggs Landing, Matceba Gardens	6.06	7.03	1.70

Note: The phase lag is relative to the tide phase at Customhouse.

Source: NOAA, 2002a.

Table 2.3 Tidal Ranges and Phases in Wando River

Station	Mean Tide Range (ft)	Spring Tide Range (ft)	Phase Lag (hours)
Fort Sumter	5.09	5.90	-0.02
Wando River at Hobcaw Point	5.76	6.68	0.18
Wando River at Parker Island	5.76	6.68	0.47
Wando River at Cainhoy	6.15	7.13	0.50
Wando River at Big Paradise Island	6.54	7.59	0.87
Wando River at Woodville	6.30	7.30	1.37

Note: The phase lag is relative to the tide phase at Customhouse.

Source: NOAA, 2002a.

Table 2.4 Tidal Current Velocities and Phases in Charleston Harbor and Cooper River

Station	Average Peak Flood Velocity (knots)	Average Peak Ebb Velocity (knots)	Phase Lag at Low Slack (hours)
Charleston Harbor Entrance, between jetties	1.8	1.8	-0.02
Charleston Harbor off Ft. Sumter	1.7	2.0	0.00
South Channel at Buoy "32"	0.8	1.0	-0.02
South Channel, 0.8 mile ENE of Ft. Johnson	0.8	2.6	0.72
South Channel, 0.4 mile NW of Ft. Johnson	0.7	1.9	1.17
The Cove, entrance on the Cove Range	1.2	0.9	0.47

Table 2.4 Tidal Current Velocities and Phases in Charleston Harbor and Cooper River

Station	Average Peak Flood Velocity (knots)	Average Peak Ebb Velocity (knots)	Phase Lag at Low Slack (hours)
Shutes Reach, Buoy "8"	1.3	1.5	0.30
Hog Island Channel	0.8	0.8	-0.65
Folly Reach at Buoy "5"	1.2	1.6	0.03
Folly Reach north of Ft. Johnson	1.2	1.1	-0.85
0.6 miles SW of Castle Pinckney	0.7	1.3	-0.35
0.4 miles west of Shutes Folly Island	0.8	2.2	0.88
Customhouse Reach off Customhouse	1.0	1.3	0.82
Customhouse Reach	1.0	1.8	0.77
Horse Reach	1.4	1.9	0.60
Hog Island Reach, Buoy "12"	1.2	1.3	0.22
Drum Island, east of bridge	1.2	2.0	0.50
Town Creek Lower Reach	1.1	2.2	0.57
Town Creek, 0.2 mile above bridge	0.8	2.5	1.10
Drum Island Reach at Buoy "45"	0.6	1.0	0.43
Cooper River, 0.2 mile above Drum Island	1.1	2.4	1.20
Cooper River at Daniel Island Reach, Buoy "48"	1.2	1.3	1.02
Cooper River at Shipyard Creek entrance	0.5	1.5	0.68
Cooper River at Daniel Island Reach	1.3	2.3	1.48
Cooper River at Daniel Island Bend	1.2	2.1	0.92
Cooper River at North Charleston	1.1	1.7	1.43
Cooper River at Filbin Creek Reach	1.2	1.8	1.52
Cooper River at Filbin Creek Reach, Buoy "58"	1.1	1.3	1.30
Cooper River at Ordnance Reach	1.0	1.2	1.58
Cooper River at Yellow House Creek	0.7	1.4	2.10
Cooper River at 1 mile NW of Yellow House Landing	0.7	1.8	2.43
Cooper River at SE of Woods Point	0.8	1.0	1.80
Cooper River at Woods Point	0.9	1.4	2.68
Cooper River at 0.5 mile North of Snow Point	1.1	1.4	2.25
Cooper River off Amoco Pier	0.7	0.9	2.15
Cooper River at 0.5 mile below Moreland	1.9	2.0	3.54
Cooper River at 1 mile below Hagan Island	1.3	1.4	3.54
Cooper River at 0.4 mile SW of the "Tee"	1.0	1.7	4.37
Cooper River at the "Tee"	0.9	1.0	3.00
Cooper River at Childsbury, Seaboard Coast Line (SCL) Railroad Bridge	0.7	1.7	4.72

Note: Phase lag is relative to the phase at Charleston Harbor off Ft. Sumter.

Source: NOAA, 2002b.

2.4 Tidal Flows

The U.S. Geological Survey (USGS) conducted tidal flow measurements at eight transects in the Charleston Harbor Estuary in September 1996: three in the Cooper River above Drum Island, two near Drum Island, two in the Wando River, and one in the Ashley River. The purpose of the flow measurements was to support the hydrodynamic calibration of a two-dimensional model development financed by Charleston Public Works Commission and the Cooper River Water Users Association (Applied Technology and Management, Inc. [ATM], 1999). Table 2.7 presents the maximum flood and ebb flow at those transects measured on two separate days. The data indicate that the maximum flood and ebb tidal flows in the Cooper River at Daniel Island Bend were approximately 150,000 and 160,000 cfs, respectively, and the maximum flood and ebb flows for Cooper River and Wando River combined (at Drum Island) were 320,000 and 360,000 cfs, respectively. As stated in Section 2.1, the annual average freshwater flows of the Cooper River were 5,470 and 5,270 cfs in 1993 and 1994, respectively. Therefore, the peak tidal flow in the Cooper River was approximately 29 times the average freshwater flow. The tidal flow averaged over the tidal cycle was estimated to be 18 times the average freshwater flow in the Cooper River.

Table 2.5 Tidal Current Velocities and Phases in Ashley River

Station	Average Peak Flood Velocity (knots)	Average Peak Ebb Velocity (knots)	Phase Lag at Low Slack (hours)
Ashley River SW of Battery	1.2	1.8	0.27
Ashley River off Wappoo Creek	1.1	1.2	0.12
Ashley River at highway bridge	1.2	1.1	-0.15
Ashley River at 0.1 mile below SCL railroad bridge	1.0	1.1	-0.10
Ashley River at 1.5 mile above SCL railroad bridge	1.2	1.5	0.37
Ashley River at State Highway 7 bridge	1.0	1.0	0.10
Ashley River at 0.1 mile east of West Marsh Island	0.7	1.0	0.38
Ashley River at Bees Ferry Bridge	1.9	2.3	1.22

Note: Phase lag is relative to the phase at Charleston Harbor off Ft. Sumter

Source: NOAA, 2002b.

Table 2.6 Tidal Current Velocities and Phases in Wando River

Station	Average Peak Flood Velocity (knots)	Average Peak Ebb Velocity (knots)	Phase Lag at Low Slack (hours)
Wando River at 0.2 mile NW of Ramley Point	1.3	1.8	-0.23
Wando River at Upper Reach, Turning Basin	1.0	1.2	-0.23
Wando River at Rathall Creek Entrance	1.3	1.7	0.42
Wando River off Nowell Creek, Buoy "19"	0.8	1.0	-0.13
Wando River at 0.2 mile above Horbeck Creek entrance	1.0	0.9	0.47
Wando River at 2.5 miles north of Horbeck Creek	0.8	1.3	0.50

Note: Phase lag is relative to the phase at Charleston Harbor off Ft. Sumter.

Source: NOAA, 2002b.

Table 2.7 Flow Measurements in Charleston Harbor Estuary (September 18 through 27, 1996)

Location	Maximum Flood Flow (cfs)	Maximum Ebb Flow (cfs)
Cooper River at Marker 104	600,000	700,000
Cooper River at Woods Point	800,000	100,000
Cooper River at Daniel Bend Island	150,000	160,000
Cooper River at US 17 Bridge	240,000	270,000
Town Creek at US 17 Bridge	800,000	900,000
Wando River at Cainhoy	65,000	50,000
Wando River near Nowell Creek	130,000	150,000
Ashley River above Old Town	60,000	65,000

Source: ATM, 1999.

2.5 Circulation and Tidal Excursion

As shown in Section 2.3, the current pattern in the Charleston Harbor Estuary is quite complex due to the spatial variability of the bathymetry and shoreline boundary geometry. Therefore, the pathway and fate of a pollutant spill in the estuary can be highly variable, depending on the location of the spill, time history of the spill, and the tidal currents during and after the spill. For example, a pollutant release from the CNC can travel upstream and downstream in the Cooper

River and Charleston Harbor Estuary and be dispersed over a large area. Conversely, pollutant spills, occurring at various locations in the estuary, even at a great distance from CNC, may be transported by tidal current and migrate to the water bodies adjacent to CNC. To estimate the spatial migration limit of a potential pollutant release from CNC, a tidal excursion analysis was conducted and presented in Section 7.2 of the *Zone J RFI Storm Water Effluent Evaluation Report.*

The excursion analysis indicates that if a pollutant is released at the northern boundary of the CNC property at low slackwater, it will be transported upstream in the Cooper River by a flood tide. Under average tidal conditions, the upstream limit of the pollutant transport will be approximately 4.3 miles from the point of release and about 1.2 miles north of the Yellow House Creek entrance, where high slackwater occurs upon the arrival of the pollutant. Although the duration of the flood tide at a fixed location is about 6.5 to 7 hours, the particle travel time from low tide to high tide is somewhat longer because of the effect of the tidal phase lag along the path of the transport. The computed upstream travel time in the Cooper River during an average tidal condition is approximately 7.5 hours. After the pollutant reaches its upstream excursion limit at high tide, it will reverse its transport direction and migrate downstream when ebb tide occurs.

The ebb tide transport pattern of a pollutant released near CNC is more complex than the flood tide transport because the current pattern in the Charleston Harbor is spatially varying and a pollutant plume may be spread out and follow various migration pathways. Part of the pollutant plume will travel south via Town Creek, and the remainder of the plume will travel southeast via Drum Island Reach.

As described in Section 2.3, the ebb current is much stronger in the western part of the harbor. The pollutant transported through Town Creek along the western estuary will move rapidly toward the harbor entrance. It is computed that the center of the western plume, originating at southern CNC, will reach Ft. Sumter when low slack tide occurs. Part of the leading plume will

be flushed and dispersed into the Atlantic Ocean, while the remaining plume will reverse its transport direction and move upstream during the next flood tide.

The flood tide may bring the pollutant into the Schooner Creek estuary near Morris Island through the inlet between Ft. Sumter and Cummings Point. Part of the returning plume will be pushed into the Ashley River during the flood tide. The computed upstream excursion limit in the Ashley River is about 3.5 miles from the entrance of the river, or near the SCL railroad bridge.

The pollutant plume from CNC moving through the Drum Island Reach and Hog Island Reach in the eastern estuary will be transported at a slower rate. It was computed that the ebbing plume that originated at southern CNC would reach its limit of transport during an ebb tide at a location about 0.5 mile southeast of the Crab Bank or about 1 mile before Ft. Moultrie near the harbor entrance. During the next flood tide, the pollutant plume will be turned upstream and can be dispersed to the Mt. Pleasant channel and Hog Island channel near Crab Bank. The plume can also be transported into the Wando River by a strong flood current. It was computed that the upstream limit of the flood tide excursion in the Wando River during average tidal conditions is about 5.6 miles from the river entrance, or near the entrance of Nowell Creek.

The pollutant plume will continue moving up and down the estuary by flood and ebb tide cycles until it is flushed out of the harbor by the net downstream transport or be diluted to negligible concentrations by tidal flows.

2.6 Water Quality

Water quality data in the Cooper River were collected by the South Carolina Department of Health and Environmental Control at several locations including Cooper River above Shipyard Creek (MD-45), Cooper River at Noisette Creek (MD-773), and Cooper River at I-526 (MD-248). Tables 2.8 through 2.10 present the water quality data summary at MD-045, MD-773, and MD-248, respectively.

Table 2.8 Water Quality Data at Cooper River above Shipyard Creek (MD-045), 1999-2000

Parameter	Unit	Mean	Minimum	Maximum	Stdev	Number of Samples
Alkalinity, Carbonate as $CaCO_3$	mg/L	73.06	56	100	11.55	18
Biochemical Oxygen Demand (BOD)	mg/L	0.54	ND	1.6	0.50	18
Cadmium	µg/L	ND	ND	ND	NA	7
Chromium	µg/L	ND	ND	ND	NA	7
Copper	µg/L	ND	ND	ND	NA	7
DO	mg/L	6.48	4.71	9.44	1.46	20
Iron	µg/L	305.7	ND	770	189.5	7
Lead	µg/L	ND	ND	ND	NA	7
Manganese	µg/L	10	ND	20	6.71	7
Mercury	µg/L	ND	ND	ND	NA	7
Nickel	µg/L	ND	ND	ND	NA	7
Nitrogen, ammonia (NH_3)	mg/L	0.15	ND	0.38	0.12	17
Nitrogen, Kjeldahl	mg/L	0.29	ND	0.51	0.12	22
Nitrogen, Nitrite (NO_2) + Nitrate (NO_3)	mg/L	0.084	0.04	0.25	0.049	22
pH	su	7.68	7.38	8.18	0.20	20
Phosphorus as P	mg/L	0.049	ND	0.11	0.0295	21
Salinity	ppt	17.6	8	28	5.3	21
Specific conductance	µmho/cm	25,567	14,000	40,000	7,279	21
Temperature, water	°C	21.8	12	31	6.3	21
Total Fecal Coliform	#/100mL	40.6	2	130	41.7	17
Total Organic Carbon (TOC)	mg/L	3.34	2.5	5.1	0.96	7
Turbidity	NTU	9.91	1.7	55	13.61	18
Zinc	µg/L	5.71	ND	20	7.87	7

Notes:

°C	=	Degrees Celsius
µg/L	=	micrograms per liter
µmho/cm	=	micro siemens per centimeter
mg/L	=	milligrams per liter
NA	=	Not Applicable
ND	=	Not Detected – Zero values were used for the mean and standard deviation computations
NTU	=	Nephelometric Turbidity Units
ppt	=	parts per thousand
STDEV	=	Standard Deviation
su	=	Standard Unit

Source: Environmental Consulting Technology, Inc. (ECT), 2002.

Table 2.9 Water Quality Data at Cooper River at Noisette Creek (MD-773), 1993

Parameter	Unit	Mean	Minimum	Maximum	Stdev	Number of Samples
Dissolved oxygen (DO)	mg/L	5.71	3.80	7.20	1.18	99
Chlorophyll a	µg/L	3.10	1.20	6.13	1.42	15
Nitrogen, ammonia (NH_3)	mg/L	0.051	0.050	0.060	0.0022	20
Unionized ammonia	mg/L	0.0014	0.00063	0.00367	0.00077	15
Nitrogen, Kjeldahl	mg/L	0.47	0.27	0.74	0.15	20
Nitrogen, Nitrite (NO_2) + Nitrate (NO_3)	mg/L	0.107	0.070	0.140	0.021	20
pH	su	7.62	7.20	8.20	0.26	15
Phosphorus as P	mg/L	0.09	0.02	0.32	0.066	20
Salinity	ppt	17.77	10.00	26.20	5.03	100
Specific conductance	µmho/cm	26,808	25	43,800	7,642	100
Temperature, water	°C	23.66	19.90	30.00	4.37	100

Source: ECT, 2002.

Table 2.10 Water Quality Data at Cooper River at I-526 (MD-248), 1999-2000

Parameter	Unit	Mean	Mini-mum	Maxi-mum	Stdev	Number of Samples
Alkalinity, Carbonate as $CaCO_3$	mg/L	60.37	41	73	8.74	19
BOD	mg/L	0.49	ND	1.1	0.42	19
Cadmium	µg/L	ND	ND	ND	NA	7
Chromium	µg/L	ND	ND	ND	NA	7
Copper	µg/L	ND	ND	ND	NA	7
DO	mg/L	6.53	4.50	9.39	1.52	22
Iron	µg/L	262.9	ND	430	141.6	7
Lead	µg/L	ND	ND	ND	NA	7
Manganese	µg/L	14.29	ND	30	8.89	7
Mercury	µg/L	ND	ND	ND	NA	7
Nickel	µg/L	ND	ND	ND	NA	7
Nitrogen, ammonia (NH_3)	mg/L	0.15	ND	0.27	0.08	19
Nitrogen, Kjeldahl	mg/L	0.32	ND	0.5	0.12	22
Nitrogen, Nitrite (NO_2) + Nitrate (NO_3)	mg/L	0.082	0.04	0.17	0.031	22
pH	su	7.66	7.17	8.40	0.28	21

Table 2.10 Water Quality Data at Cooper River at I-526 (MD-248), 1999-2000

Parameter	Unit	Mean	Mini-mum	Maxi-mum	Stdev	Number of Samples
Phosphorus as P	mg/L	0.050	ND	0.14	0.0322	21
Salinity	ppt	12.6	5	21	4.2	23
Specific conductance	µmho/cm	18,869	9,000	31,000	6,019	23
Temperature, water	°C	21.4	11.5	31	6.2	23
Total Fecal Coliform	#/100 mL	33.3	7	140	30.7	19
Total Organic Carbon (TOC)	mg/L	3.77	1.7	10	2.13	7
Turbidity	NTU	5.09	1.7	10	2.24	19
Zinc	µg/L	15.71	ND	50	17.18	7

Source: ECT, 2002.

Salinity monitoring has been conducted by USGS in the Cooper River at Army Depot near North Charleston since 1992. Continuous salinity data were recorded near water surface and near bottom. Statistical analysis of the salinity data indicated that the average near-surface salinity was 11.3 ppt and varied from 0.1 to 26.4 ppt. The average near-bottom salinity was 14.3 ppt and varied from 0.3 to 33.9 ppt. The average daily salinity fluctuation near-surface was 10.8 ppt, and the average daily salinity fluctuation near-bottom was 12.1 ppt. The average salinity difference from near-surface to near-bottom was 2.9 ppt. The data showed that the daily changes in salinity were much greater than vertical salinity stratification.

2.7 Drainage

Drainage basins were delineated based on information contained in the CNC drainage evaluation (Davis and Floyd, 1998), the North Charleston drainage inventory (Davis and Floyd, 1980), and USGS quadrangles. The delineated basins are presented on Figure 2-9. The total area that drains into the Cooper River along the CNC shoreline fronting the river is approximately 1,326 acres, including tidal marsh areas, and 440 acres of offsite drainage area. Tidal marsh areas comprise approximately 37 acres within the CNC property and 7 acres offsite. Therefore, the total upland drainage area (minus tidal marsh area) that drains into Cooper River basin along the property boundary is approximately 1,282 acres. About 849 acres of the upland drainage area is located

within the CNC property, comprising about 66 percent of the total upland drainage area. The remaining offsite upland drainage area (433 acres) is located within the City of North Charleston.

There are 86 storm water outfalls in the Cooper River basin within CNC boundary. The inventory of these outfalls is presented in Table 2.11. Runoff from offsite drainage areas drain into the Cooper River via Outfall 37, a 42- by 60-inch box culvert.

A major factor in the determination of the diluting and flushing capacity of a tidal river is the quantity (volume and rate) of storm water runoff which enters the river as compared to the magnitude of the tidal water exchange in the river. Estimates of storm water runoff were calculated for comparison with tidal flows in the river. Estimates of runoff volumes and peak flow rates were prepared for annual average rainfall volume; the mean storm event; and larger, infrequent storm events.

Table 2.11 Cooper River Storm Water Outfall Inventory

Drainage Basin ID	Outfall ID	Diameter (inches)	Drainage Area (acres)	Sample ID	Comments
1	1	18	6.967	EFF001	
2	2	18	3.501	EFF005	
3	3	18	16.426	EFF006	
4	4	18	2.791	No effluent sample collected	
5	5	12	5.424	No effluent sample collected	
6	6	36	1.594	No effluent sample collected	
7	7	18	1.692	No effluent sample collected	
8	8	18	2.169	No effluent sample collected	
8A	8A	12	0.143	No effluent sample collected	
15	15	6	0.68	No effluent sample collected	
16	16	4	0.16	No effluent sample collected	
17	17	8	1.00	No effluent sample collected	
18	18	18	8.44	EFF013	
19	19	20	13.23	No effluent sample collected	
20	20	60	75.96	EFF014	

Table 2.11 Cooper River Storm Water Outfall Inventory

Drainage Basin ID	Outfall ID	Diameter (inches)	Drainage Area (acres)	Sample ID	Comments
21	21	12	0.84	No effluent sample collected	
22	22	30	7.50	EFF015	
23	23	30	22.13	EFF016	
24	24	24	1.20	No effluent sample collected	
25	25	24	1.74	No effluent sample collected	
26	26	30	2.23	EFF017	
27	27	18	8.50	EFF018	
28	28	36	74.72	EFF019	
28A	-	-	4.14	No effluent collected	Discharges to Outfall 28
29	29	18	2.65	No effluent collected	
30	30	48	33.16	EFF020	
30-B	-	-	0.20	No effluent collected	Discharges to Outfall 30
30-C	-	-	0.17	No effluent collected	Discharges to Outfall 30
30A	30A	12	0.22	EFF021	
31	31	30	3.06	EFF022	
32	32	30	6.57	EFF023	
33	33	18	4.99	EFF024	
33A	33A	8	0.61	No effluent sample collected	
34	34	30	36.46	EFF025	
34A	34A	8	0.56	No effluent sample collected	
34B	34B	12	0.84	No effluent sample collected	
35	35	30	19.09	EFF026	
36	36	14	2.99	EFF027	
37	37	42 X 60	8.88	EFF028	
37A	-	-	9.45	No effluent sample collected	Discharges to Outfall 37
37B	-	-	11.53	No effluent sample collected	Discharges to Outfall 37
37C	-	-	6.23	No effluent sample collected	Discharges to Outfall 37
37D	-	-	6.38	No effluent sample collected	Discharges to Outfall 37
38	38	36	21.94	EFF029	
39	39	10	0.55	EFF030	
40	40	18	2.56	EFF031	
41	41	18	5.85	EFF032	
42	42	18	0.49	No effluent sample collected	
42A	42A	12	0.79	EFF033	

Table 2.11 Cooper River Storm Water Outfall Inventory

Drainage Basin ID	Outfall ID	Diameter (inches)	Drainage Area (acres)	Sample ID	Comments
43	43	54	20.56	EFF034, EFF035	
43A	-	-	5.78	No effluent sample collected	
43B	43B	24	-	EFF037	
43A	-	36	-	EFF036	
44	44	18	8.02	EFF038	
45	45	18	10.81	EFF039	
44/46A	44/46A	-	9.61	No effluent sample collected	
45A	45A	15	-	No effluent sample collected	
45B	45B	-	-	No effluent sample collected	
45C	45C	-	-	No effluent sample collected	
45D	45D	15	-	No effluent sample collected	
46A	46A	15	-	No effluent sample collected	
46	46	2-20	4.36	No effluent sample collected	
46-B	46-B	15	0.51	No effluent sample collected	
47	47	69 X 69	89.68	EFF040, EFF041, EFF042, EFF043	
47A	47A	8	1.54	EFF044	
47B	47B	8	1.66	EFF045	
48	48	54	27.57	EFF046, EFF047, EFF048	
48A/48G			10.84	No effluent sample collected	
'	48A	15		EFF049	
'	48B	15		EFF050	
'	48C	15		EFF051	
'	48D	15		EFF052	
'	48E	15		EFF053	
'	48F	15		EFF054	
'	48G	15		EFF055	
48H	48H	18	2.49	EFF056	
48I-48M			1.81	No effluent sample collected	
'	48I	12		No effluent sample collected	
'	48J	12		No effluent sample collected	
'	48K	12		No effluent sample collected	
'	48L	15		No effluent sample collected	
'	48M	12		No effluent sample collected	

Table 2.11 Cooper River Storm Water Outfall Inventory

Drainage Basin ID	Outfall ID	Diameter (inches)	Drainage Area (acres)	Sample ID	Comments
49	49	54	20.58	EFF057	
49A/49C			7.37	No effluent sample collected	
'	49A	12		No effluent sample collected	
'	49B	18		No effluent sample collected	
'	49C	15		No effluent sample collected	
50	50	Ditch	3.25	No effluent sample collected	
51	51	48	28.59	EFF058	
51-A	51-A	18	3.30	No effluent sample collected	
51-B	51-B	20	3.92	No effluent sample collected	
51-C	51-C	18	9.17	EFF059	
51-D	51-D	18	2.49	EFF060	
51-E	51-E	18	4.10	EFF061	
51-F	51-F	-	26.09	EFF062	
51-G	51-G	-	18.86	No effluent sample collected	
51-I	51-I	-	16.61	No effluent sample collected	
53	-	-	10.02	EFF070	Discharges to Outfall 37

Runoff estimates require an evaluation of the area's rainfall statistics, topography, and drainage infrastructure for the determination of drainage basins, and land cover including estimates of impervious surface area. These evaluations were carried out for the Cooper River basins within the project area. Details and results of the evaluation are presented in the following sections.

Land Cover

Using the available geographic information system (GIS) coverage for the CNC, the area of impervious cover and open space was computed. Land cover characteristics outside of the CNC were determined using aerial photographs, USGS quadrangles, and the SCDNR land use/land cover GIS data. The following table provides a break down of land cover characteristics in the Cooper River drainage basin.

Commercial	171 acres
Residential	262 acres
Open space (within CNC)	318 acres
Marsh	44 acres
Impervious (within CNC)	524 acres
Gravel	17 acres

Rainfall

Charleston County receives on average approximately 51 inches of rainfall per year. This is based on records maintained by the SCDNR Office of Climatology. The SCDNR has compiled rainfall data records from 1930 to 2000. The USEPA has also compiled data for selected regions of the country and determined mean rainfall event statistics for these regions as part of National Pollutant Discharge Elimination System (NPDES) storm water sampling protocol development. The mean storm event for the southeast region of the country including Charleston was determined to be 0.75 inches of rainfall (Urban Targeting and Best Management Practices [BMP] Selection, EPA Region 5, November 1990). Using the most current National Weather Service data, the Natural Resources Conservation Service (NRCS) has compiled infrequent-event rainfall amounts. The following table presents the rainfall depths of 24-hour storm events for various return periods (2 to 100 years) for the Charleston, South Carolina, area.

Return Period (years)	Rainfall Depth (inches)
2	4.6
5	5.9
10	6.8
25	7.8
50	8.8
100	10

Surface Runoff Estimates

Peak runoff rates for a number of storm events were determined using the NRCS Technical Release No. 55 (TR55) methodology. Runoff volumes were computed using NRCS methodology for all storm events except for the mean rainfall event in which runoff volumes for the mean

rainfall event were computed using the rational method. A summary of surface runoff to the Cooper River along the CNC shoreline is presented in Table 2.12.

On an annual average basis, the average runoff rate to the Cooper River along the CNC shoreline is estimated to be 5.1 cfs, of which approximately 3.4 cfs is contributed by the CNC property. The annual average runoff rate of 5.1 cfs comprises approximately 0.1 percent of the total fresh-water flow in the Cooper River.

The peak runoff rates presented in Table 2.12 represent the direct runoff from the land surface and do not represent the peak discharge rates at the storm water outfalls. The peak outfall discharge rates will be smaller than the peak surface runoff rates because the discharge from the drainage conveyance system is attenuated by hydraulic routing and storage effects and is constrained by the physical size of the storm water pipes and outfall structures.

Table 2.12 Summary of Surface Runoff to Cooper River along the CNC Shoreline

	Mean Event	Return Period (Years)					
		2	5	10	25	50	100
Rainfall (inches)	0.75	4.6	5.9	6.8	7.8	8.8	10
Peak Runoff Rate (cfs)	—	1,939	2,607	3,065	3,568	4,077	4,685
Total Runoff Volume (acre-ft)	53.0	385.8	524.7	621.8	730.3	839.1	970.2
Runoff from CNC (acre-ft)	34.9	265.4	358.8	424.0	496.7	589.6	657.4

Source: ECT, 2002.

The runoff analysis indicates that the total runoff volume from CNC and the adjacent offsite area for a 24-hour, 25-year storm is 497 acre-ft, which is approximately 0.5 percent of the total tidal flow volume in the Cooper River within one tidal cycle (12.4 hours). The total runoff volume for a 24-hour, 100-year storm (658 acre-ft) is about 0.6 percent of the Cooper River tidal flow volume within one tidal cycle.

Runoff estimates were also made for the drainage basins of several individual outfalls of various sizes in the CNC. These outfalls were selected according to their large contributing drainage area as compared to other outfalls of the same size. The selected outfalls represent a cross section of the outfalls along CNC shoreline that may cause the most severe impacts to the Cooper River water quality. Surface runoff estimates were computed in the same manner as described above. Table 2.13 presents the runoff summary associated with the selected outfalls. The values represent surface runoff and do not take into account any attenuation due to storm sewers or any other hydraulic structures. A full hydrologic and hydraulic model would be necessary to accurately determine peak discharge rates and is outside the scope of this study; however, the peak runoff estimates presented in Table 2.13 represent a worst-case hydraulic loading to the Cooper River.

Estimates of long-term sediment loads into the Cooper River from CNC were performed using the Watershed Treatment Model (WTM), developed by the Center for Watershed Protection (CWP) as part of an EPA grant. WTM was developed to assist watershed managers in assessing pollutant loads in their watershed and effective BMPs to reduce them. Pollutant loads for urban areas are estimated using the *constant concentration* method in which loads are characterized as a product of estimated flows and event mean concentrations (EMCs). The estimated wet season and annual rainfall in the project area is 20.2 and 52 inches, respectively. The WTM uses compiled storm water pollutant EMC data from a number of studies conducted throughout the United States by the CWP. These data were used in the computation of estimated long-term sediment loads from CNC into the Cooper River.

The sediment loads were estimated using only primary sources (storm water runoff). They did not account for any possible secondary sources such as illicit connections, stream erosion, and active construction. They also did not account for any storm water treatment processes (BMPs) which would reduce loadings. Based on analysis of aerial photographs, BMP implementation in the basin appears to be minimal.

The estimated long-term annual average sediment loads to the Cooper River along CNC shoreline is 700,000 pounds per year, and the long-term average wet-season sediment load is 280,000 pounds per wet season.

Assuming a sediment bulk density of 90 pounds per cubic feet, the estimated annual sediment load to the Cooper River is 288 cubic yards per year.

Sediment in the storm water runoff is composed of soil material with various grain sizes, ranging from fine clay to coarse sand. Fine clay particles can be kept in suspension in the water column by fluid turbulence and be carried significant distances. Silt material may be transported as a suspended load by tidal flow for a distance until it settles to the bottom. From then on, it is transported by currents in the form of bed load. Coarse sand and gravel are usually deposited to the river bottom in the vicinity of outfall.

Table 2.13 Surface Runoff Summary for Drainage Basins Associated with Selected Outfalls

Outfall ID	Pipe Size (inches)	Drainage Area (acres)	Peak Runoff Rate (cfs) Return Period (Years)						Total Runoff Volume (acre-ft) Return Period (Years)					
			2	5	10	25	50	100	2	5	10	25	50	100
19	20	13.2	25	32	37	42	47	54	4.7	6.1	7.1	8.2	9.3	10.6
20	60	76.0	127	169	198	230	262	301	22.8	30.8	36.3	42.6	48.8	56.4
28	36	78.9	137	181	211	243	277	316	25.0	33.4	39.3	45.8	52.3	60.1
34	30	36.5	66	86	99	114	130	147	12.2	16.1	18.9	21.9	24.9	28.5
37	42 X 60	525.7	792	1,088	1,291	1,516	1,739	2,010	139.8	193.7	231.6	274.0	316.7	368.2
45	18	10.8	19	25	29	33	38	43	3.4	4.6	5.4	6.3	7.2	8.2
47	69 X 69	89.7	148	198	232	269	307	352	26.9	36.3	42.9	50.3	57.7	66.5

Source: ECT, 2002.

Based on the sediment grain size distribution information for urban runoff provided by the USEPA (1983), Wanielista and Yousef (1993) compiled a table that relates the percentage of sediment mass in storm water to the average settling velocity as presented in Table 2-14. The settling times of the sediment particles for each size category in 40 ft of water (the typical depth in the Cooper River near CNC) are also shown in Table 2-14. It indicates that 40 percent of sediment constituting the finest grain sizes may be transported in suspension almost indefinitely until it reaches and stays in quiescent water for a long period of time. The median 20 percent of the sediment grain sizes found in storm water can be transported and dispersed by currents for multiple tide cycles and be deposited to the bottom over a wide area. The next 20 percent of the coarser material can be deposited to the bottom within one tidal cycle at a large distance (up to 6 miles) from the outfall. Only 20 percent, representing the largest sediment particles can be deposited within 1 mile from the outfall.

Table 2.14 Percentage of Particle Mass in Storm water as Related to Average Settling Velocity

Cumulative Percent of Mass in Urban Runoff	Average Settling Velocity (feet/hour)	Settling Time in 40 ft of Water (hour)
0 to 20	0.03	1,670
20 to 40	0.33	152
40 to 60	1.5	27
60 to 80	7	5.7
80 to 100	70	0.6

Sources: Wanielista and Yousef, 1993.
USEPA, 1983.
ECT, 2002.

Because of the complex tidal current and circulation pattern in the Charleston Harbor Estuary, as described in Sections 1.3 and 1.5, the sediments originating from CNC can be transported over a large area in the form of either suspended load or bed load. The sediment can be deposited or accumulated in various parts of the estuary. The highest probability of deposition, or accretion, will likely occur in areas with low tidal energy. These low energy zones may include the dry dock area in Zone E, the Shipyard Creek, and near-shore shallow area in Zone I, Middle Ground southeast of the Shutes Follow Island, shallow area near the Crab Bank, Hog Island Channel, Mt. Pleasant Channel, and the embayment near Morris Island.

3.0 DATA VALIDATION

3.1 Introduction

Section 4.1 of the *Zone A RFI Report* (EnSafe, April 1998) defines the DQOs used for the Zone J investigation. For the RFI at Zone J, analytical Level III data for semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), target analyte list (TAL) metals, and cyanide were deemed appropriate for the intended data uses: drainage basin storm water characterization, ecological risk assessment, and corrective measure determinations/design. For the Zone J Storm Water Effluent Evaluation Report Addendum, samples collected from 38 drainage basins with storm water runoff associated with the Cooper River were analyzed.

Appendix A includes the complete analytical data reports, data validation reports and chain of custodies for the Zone J RFI.

It should be noted that in September 1993, the USEPA replaced the 1987 guidance with an updated manual, *Data Quality Objectives Process for Superfund, Interim Final Guidance*, EPA/540/G-93/071 (USEPA, September 1993), which stated, "This guidance replaces the earlier guidance EPA 540/G-87/003, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-7B and the five analytical levels introduced in that document." As a result, the five analytical data levels were reduced to two — screening data and definitive data.

Definitive data (formerly Levels III and IV) are defined as analytical data generated using rigorous analytical methods, such as approved USEPA reference methods. These data are analyte-specific, with confirmation of analyte identity and concentration. These approved methods produce tangible raw data (e.g., chromatograms, spectra, digital values, etc.) in paper printouts or computer-generated electronic files. Analytical or total measurement error (precision) must be determined for data to be definitive (USEPA, September 1993). As a result, the data collected at Zone J were defined as definitive data per the most recent USEPA guidance but will still be referred to as Level III throughout the report to avoid confusion.

3.2 Validation Summary

This section presents the quality assurance/quality control (QA/QC) evaluation of the data produced from the analysis of storm water effluent samples collected in Zone J during the RFI. This evaluation will verify that the appropriate QA/QC elements were followed and/or completed (e.g., method requirements, documentation, etc.) to identify and/or characterize any problems with the data set, and ultimately to determine the usability of the analytical data for site characterization, risk assessment, and corrective measure determinations.

Examples of definitive data (formerly Level III and IV) QA/QC elements are as follows:

- Sample documentation (verified time of sample receipt, extraction and holding times)
- Chain of custody
- Initial and continuing calibration
- Determination and documentation of detection limits
- Analyte(s) identification
- Analyte(s) quantification
- QC blanks (trip, method, rinsate)
- Matrix spike recoveries
- Performance evaluation (PE) samples (when specified)
- Analytical method precision
- Total measurement error determination

Cooper River storm water effluent samples were collected from January 2002 to September 2002 and analyzed by Severn Trent Laboratories/Savannah, Georgia facility, a SCDHEC certified laboratory. In accordance with the approved work plan, sample analyses followed the guidance in the *USEPA Test Methods for Evaluating Solid Waste*, SW-846 (USEPA, 1992) and Title 40 Code of Federal Regulations (CFR) Part 264. Table 3.1 summarizes the analytical methods and DQO laboratory deliverables.

Table 3.1
Charleston Naval Complex Analytical Program

Full Scan/Appendix IX Analytical Methods	Data Quality Level	Method Reference
SVOCs	III	SW-846 8270C
PCBs	III	SW-846 8081A/8082
Target Analyte List Metals	III	SW-846 6010B/7470A/7471A

Table 3.1
Charleston Naval Complex Analytical Program

Full Scan/Appendix IX Analytical Methods	Data Quality Level	Method Reference
Cyanide	III	USEPA 9012B
Salinity*	III	Standard Method 2520B

Notes:
* Salinity method was not originally listed as a parameter to be analyzed in the Point of Entry Effluent Evaluation Work Plan. Salinity was later added to distinguish storm water effluent runoff from tidal influence. TAL Metals include tin.

The methods listed in Table 3.1 are from:

- USEPA OSWER, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846), Third Edition, Update III, November 1997.
- American Public Health Association, *Standard Methods for the Examination of Water and Wastewater*, 19th edition.

Third-party independent data validation of all analytical work by Heartland Environmental Services, Inc. based on the QC criteria developed for USEPA Contract Laboratory Program (CLP). The third–party validator's function was to assess the quality and reliability of the data to determine its usability, documenting any mitigating factors such as noncompliance with methods, possible matrix interferences, and laboratory blank contamination.

3.3 Organic Evaluation Criteria

Section 4.2.1 of the *Zone A RFI Report* discusses the organic evaluation criteria as they apply to the Zone J storm water effluent investigation. These include holding times, instrument performance standards, surrogate spike recoveries, instrument calibration, matrix spikes/duplicates, laboratory control samples and laboratory duplicates, blank analysis, field–derived blank analyses, and internal performance standards.

3.4 Diluted Samples

There were no samples diluted due to high concentrations of contamination during the Cooper River storm water evaluation.

3.5 Inorganic Evaluation Criteria

Section 4.2.2 of the *Zone A RFI Report* discusses the inorganic evaluation criteria as they apply to the Zone J investigation. These include holding times; instrument calibration; blank analysis; inductively coupled argon plasma (ICAP) interference check samples; laboratory control samples (LCS); spike sample analyses; laboratory duplicates; ICAP serial dilutions; and atomic absorption (AA) analysis, duplicate injections, and postdigestion spikes.

3.6 Zone J Data Validation Reports

A complete copy of the Zone J data validation reports for the evaluations described above is included in Appendix A for review. During the data validation review of Zone J storm water analyses, site–specific deficiencies and/or problems were noted in the semivolatile and metals methods. The following sections present analytes detected in blank samples analyzed during the storm water investigation.

3.7 Blank Data

Cooper River

SDG NBCJ02 — metals method

1. Aluminum, calcium, copper, manganese, sodium, zinc in the equipment blank

2. Aluminum, arsenic, barium, beryllium, calcium, copper, lead, potassium, selenium, tin, and zinc in the laboratory blank. Aluminum blank results (155 micrograms per liter [μg/L]) impacted sample CAP001 associated with this sample delivery group (SDG). The aluminum results were 18 μg/L, and after data validation the results were reported as non-detect.

SDG NBCJ03 — metals method

1. Arsenic, calcium, lead, mercury, sodium, and zinc in the laboratory blank. Lead results in the laboratory blank (16.5 μg/L) impacted one sample (EFF058) associated with this SDG. The lead result was 4.3 μg/L in the sample and after data validation was implemented the final results were reported as non-detect.

SDG NBCJ04 — metals method

1. Calcium, manganese, and nickel in the laboratory blank. Blank data did not impact the associated sample data for this SDG.

SDG NBCJ05 — metals method

1. Aluminum, barium, cadmium, calcium, copper, magnesium, and zinc in the laboratory blank. Copper results in the blank data (2.79 μg/L) impacted the following samples: EFF01, EFF41, EFF42, EFF47. The copper results were 7.8μg/L, 5.5 μg/L, 6.2 μg/L, and 6.3 μg/L in the samples, respectively, and after data validation was implemented the final results were reported as non-detect. . Zinc results in the blank data (16.7 μg/L) impacted samples EFF42 and EFF47. The zinc results were 71 μg/L and 57 μg/L in the samples, respectively, and after data validation was implemented the final results were reported as non-detect.

SDG NBCJ06 — metals method

1. Aluminum, beryllium, and zinc in the laboratory blank. Beryllium results in the blank data (2.9 μg/L) impacted the following samples: EFF013, EFF019, EFF031, EFF034, EFF035, EFF044, EFF047, and EFF057. The beryllium results were 0.54 μg/L, 0.60 μg/L, 0.35 μg/L, 0.38 μg/L, 0.43 μg/L, 0.32 μg/L, 0.33μg/L, and 0.34 μg/L, respectively, and after data validation was implemented the final results wee reported as non-detect.

SDG NBCJ08 — metals method

1. Aluminum, arsenic, calcium, copper, iron, magnesium, selenium, sodium, thallium, vanadium, and zinc in the laboratory blank. Blank data did not impact the samples associated with this SDG.

SDG NBCJ09— metals method

1. Calcium, cobalt, copper, silver, and sodium in the laboratory blank. Blank data did not impact the samples associated with this SDG.

SDG NBCJ10— metals method

1. Aluminum, calcium, selenium, sodium, thallium, and zinc in the laboratory blank. Blank data did not impact the samples associated with this SDG.

SDG NBCJ10— semivolatiles method

1. Bis(2 Ethylhexy)phthalate and di-n-butylphthalate in the laboratory blank. Blank data did not impact the samples associated with this SDG.

SDG NBCJ11— metals method

1. Calcium and copper in the laboratory blank. Blank data did not impact the samples associated with this SDG.

SDG NBCJ11— semivolatiles method

1. Benzo(g,h,i)perylene in the laboratory blank. Blank data did not impact the samples associated with this SDG.

SDG NBCJ12— metals method

1. Aluminum, arsenic, calcium and selenium in the laboratory blank. Selenium results in the blank data (27.1 μg/L) impacted the following samples to report results as non-detect: EFF039, EFF049, EFF052, and EFF053. Non-validated results were reported as 4μg/L, 6.4 μg/L, 3.5 μg/L, and 8.3 μg/L respectively.

SDG NBCJ13— metals method

1. Calcium and copper in the laboratory blank. Blank data did not impact samples associated with this SDG.

SDG NBCJ14— metals method

1. Calcium, copper, tin, and zinc in the laboratory blank. Tin results in the blank data (3.07 μg/L) impacted sample EFF028 to be reported as non-detect. The non-validated tin result for EFF028 was 4.9 μg/L.

SDG NBCJ16— metals method

1. Calcium, copper, and lead in the laboratory blank Cooper and lead results in the blank data impacted sample EFF016 results to be reported as non-detect. The non-validated copper and lead results for EFF016 were 22 μg/L and 7.4 μg/L., respectively.

3.8 Method Detection Limit (MDL)

The MDL is the minimum concentration above zero that an analyte can be detected with 99% confidence. Tables 3.2 through 3.5 show the MDL study from Severn Trent Laboratories/Savannah.

Table 3.2
Zone J Storm Water Effluent Evaluation Addendum
Severn Trent Laboratories/Savannah Method Detection Limit Study for SVOCs

Compound	CAS Number	PQLs Water (µg/L)	PQLs Soil (µg/kg)	MDLs Water (µg/L)	MDLs Soil (µg/kg)
Semivolatile					
Test Code:	**MS500**				
Method:	**SW846 8270, 823rd Edition, Nov. 1986, PQL Table II, Rev.0, Sept. 1986**				
Matrix:	**Water–Soil**				
Extract Volume:	**1000 mL – 30g**				
Initial Calibration:	**20–50–100–120–160 ng,%RSD for CCC = 30%, SPCC=97RF > 0.05**				
Continuing Calibration:	**50 ng, %D = 25% for CCC, SPCC = RF > 0.05100**				
Phenol	108–95–2	10	330	0.28	42.0
bis(2–chloroethyl)ether	111–44–4	10	330	0.44	26.0
2–Chlorophenol	95–57–8	10	330	0.24	32.0
1,3–Dichlorobenzene	541–73–1	10	330	0.32	31.0
1,4–Dichlorobenzene	106–46–7	10	330	0.29	27.0
1,2–Dichlorobenzene	95–50–1	10	330	0.31	24.0
2–Methylphenol	95–48–7	10	330	0.29	32.0
bis(2–chloroisopropyl)ether	108–60–1	10	330	0.23	33.0
4–Methylphenol	106–44–5	10	330	0.71	42.0
N–Nitroso-di–n–propylamine	621–64–7	10	330	0.29	32.0
Hexachloroethane	67–72–1	10	330	0.32	24.0
Isophorone	78–59–1	10	330	0.37	26.0
Nitrobenzene	98–95–3	10	330	0.31	27.0
2–Nitrophenol	88–75–5	10	330	0.36	19.0
2,4–Dimethylphenol	105–67–9	10	330	0.39	28.0
bis(2–chloroethoxy)methane	111–91–1	10	330	0.26	29.0
2,4–Dichlorophenol	120–83–2	10	330	0.66	31.0
1,2,4–Trichlorobenzene	120–82–1	10	330	0.36	22.0

Table 3.2
Zone J Storm Water Effluent Evaluation Addendum
Severn Trent Laboratories/Savannah Method Detection Limit Study for SVOCs

		PQLs		MDLs	
Compound	**CAS Number**	**Water (μg/L)**	**Soil (μg/kg)**	**Water (μg/L)**	**Soil (μg/kg)**
Naphthalene	91–20–3	10	330	0.36	25.0
4–Chloroaniline	106–47–8	10	330	0.98	37.0
Hexachlorobutadiene	87–68–3	10	330	0.35	23.0
4–Chloro–3–methylphenol	59–50–7	10	330	0.33	49.0
2–Methylnaphthalene	91–57–6	10	330	0.33	32.0
Hexachlorocyclopentadiene	77–47–4	10	330	2.4	51.0
2,4,6–Trichlorophenol	88–06–2	10	330	0.35	20.0
2,4,5–Trichlorophenol	95–95–4	25	830	0.74	29.0
2–Chloronaphthalene	91–58–7	10	330	0.39	24.0
2–Nitroaniline	88–74–4	25	830	5.3	42.0
Dimethylphthalate	131–11–3	10	330	0.39	25.0
Acenaphthylene	208–96–8	10	330	0.33	21.0
2,6–Dinitroltoluene	606–20–2	10	330	0.34	29.0
3–Nitroaniline	99–09–2	25	830	5.0	32.0
Acenaphthene	83–32–9	10	330	0.25	29.0
2,4–Dinitrophenol	51–28–5	25	830	0.80	150.0
4–Nitrophenol	100–02–7	25	830	4.9	160.0
Dibenzofuran	132–64–9	10	330	0.29	30.0
2,4–Dinitrotoluene	121–14–2	10	330	0.41	40.0
Diethylphthalate	84–66–2	10	330	0.47	32.0
Fluorene	86–73–7	10	330	0.38	31.0
4–Chlorophenyl–phenylther	7005–72–3	10	330	0.66	28 .0
4–Nitroaniline	100–01–6	25	830	7.7	42.0
4,6–Dinitro–2–methylphenol	534–52–1	25	830	5.0	200.0
N–nitrosodiphenylamine	86–30–6	10	330	5.4	25.0
4–Bromophenyl–phenylether	101–55–3	10	330	0.35	24.0
Hexachlorobenzene	118–74–1	10	330	0.19	45.0

Table 3.2
Zone J Storm Water Effluent Evaluation Addendum
Severn Trent Laboratories/Savannah Method Detection Limit Study for SVOCs

		PQLs		MDLs	
Compound	**CAS Number**	**Water (μg/L)**	**Soil (μg/kg)**	**Water (μg/L)**	**Soil (μg/kg)**
Pentachlorophenol	87–86–5	25	830	4.0	180.0
Phenanthrene	85–01–8	10	330	0.33	17.0
Anthracene	120–12–7	10	330	0.33	21.0
Di–n–butylphthalate	84–74–2	10	330	0.26	28.0
Fluoranthene	206–44–0	10	330	0.33	31.0
Pyrene	129–00–0	10	330	0.53	63.0
Buytylbenzylphthalate	85–68–7	10	330	0.41	42.0
Benzo(a)anthracene	56–55–3	10	330	0.30	20.0
3,3'–Dichlorobenzidine	91–94–1	10	330	4.4	150.0
Chrysene	218–1–9	10	330	0.44	21.0
bis(2–ethylhexyl)phthalate	117–81–7	10	330	0.48	45.0
Di–n–octylphthalate	117–84–0	10	330	0.35	54.0
Benzo(b)fluoranthene	205–99–2	10	330	0.28	23.0
Benzo(k)fluoranthene	207–08–9	10	330	0.72	26.0
Benzo(a)pyrene	50–32–8	10	330	0.41	29.0
Indeno(1,2,3–cd)pyrene	193–39–5	10	330	0.56	67.0
Dibenz(a,h)anthracene	53–70–3	10	330	0.80	52.0
Benzo(g,h,i)perylene	191–24–2	10	330	0.68	26.0

Notes:
CAS = Chemical Abstracts Service
CCC = Calibration Check Compounds
g = grams
MDL = Method Detection Limit
mL = milliliters
ng = nanograms
PQL = Practical Quantitation Limit
RF = Response Factor
RRF = Relative Response Factor
SPCC = System Performance Calibration Compounds
%D = Percent difference
%RSD = Percent Relative Standard Deviation
μg/kg = micrograms per kilogram

Table 3.3
Zone J Storm Water Effluent Evaluation Addendum
Severn Trent Laboratories/Savannah Method Detection Limit Study for Pesticides/PCB

		PQLs		MDLs	
Compound	**CAS Number**	**Water (μg/L)**	**Soil (μg/kg)**	**Water (μg/L)**	**Soil (μg/kg)**
Pesticide/PCB					
Test Code:	**GC800**				
Method:	**SW846 8080A, 3rd Edition, Nov. 1986**				
Matrix:	**Water–Soil**				
Extract Volume:	**1000 mL – 30g**				
Initial Calibration:	**5 point calibration, %RSD=20%**				
Continuing Calibration:	**Single point calibration, %D = 15%**				
alpha–BHC	319–84–6	0.04	1.3	0.0079	0.13
beta–BHC	319–85–7	0.04	1.3	0.0074	0.62
delta–BHC	319–86–8	0.04	1.3	0.012	0.083
gamma–BHC(Lindane)	58–89–9	0.04	1.3	0.0074	0.57
Heptachlor	76–44–8	0.04	1.3	0.0062	0.20
Aldrin	309–00–2	0.04	1.3	0.0099	0.15
Heptachlor epoxide	1024–57–3	0.04	1.3	0.0069	0.12
Endosulfan I	959–98–8	0.04	1.3	0.0094	0.14
Dieldrin	60–57–1	0.08	2.5	0.012	0.24
4,4–DDE	72–55–9	0.08	2.5	0.014	0.24
Endrin	72–20–8	0.08	2.5	0.014	0.42
Endosulfan II	33213–65–9	0.08	2.5	0.018	0.43
4'4'–DDD	72–54–8	0.08	2.5	0.018	0.35
Endosulfan sulfate	1031–07–8	0.08	2.5	0.020	0.44
4'4–DDT	50–29–3	0.08	2.5	0.017	0.35
Methoxychlor	72–43–5	0.38	12.5	0.038	0.51
Endrin ketone	53494–70–5	0.08	2.5	0.020	0.65
Endrin aldehyde	7421–36–3	0.08	2.5	0.021	0.24
alpha–Chlordane	5193–71–9	0.04	1.3	0.0076	0.23
gamma–Chlordane	5103–74–2	0.04	1.3	0.0074	0.20
Toxaphene	8001–35–2	2.5	83	1.0	33
Aroclor–1016	12674–11–2	1	33	0.21	5.7
Aroclor–1221	11104–28–2	1	33	0.36	7.6

Table 3.3
Zone J Storm Water Effluent Evaluation Addendum
Severn Trent Laboratories/Savannah Method Detection Limit Study for Pesticides/PCB

		PQLs		MDLs	
Compound	**CAS Number**	**Water (μg/L)**	**Soil (μg/kg)**	**Water (μg/L)**	**Soil (μg/kg)**
Aroclor–1232	11141–16–5	1	33	0.095	3.5
Aroclor–1242	53469–21–9	1	33	0.20	6.5
Aroclor–1248	12672–29–6	1	33	0.13	5.9
Aroclor–1254	11097–69–1	1	33	0.22	8.2
Aroclor–1260	11096–82–5	1	33	0.11	8.0

Table 3.4
Zone J Storm Water Effluent Evaluation Addendum
Severn Trent Laboratories/Savannah Method Detection Limit Study for
Metals by Low–Level Inductively Coupled Plasma (ICP) Method

		PQLs		MDLs	
Compound	**CAS Number**	**Water (μg/L)**	**Soil (mg/kg)**	**Water (μg/L)**	**Soil (mg/kg)**
Metals reporting limits by Low Level ICP **Method:** **SW846 Third Edition, Nov. 1986, Method 6010A** **Matrix:** **Water–Soil** **Extract Volume: 100mL – 1g** **Initial Calibration:** **0-500μg/L – varies** **Continuing Calibration: ½ high standard**					
Aluminum	7429–90–5	200.0	10	9.6	37.9
Antimony	7440–36–0	20.0	1.5	3.0	5.0
Arsenic	7440–38–2	10.0	1.0	3.5	2.8
Barium	7440–39–3	10.0	1.0	0.30	0.8
Beryllium	7440–41–7	4.0	0.3	0.1	0.9
Cadmium	7440–43–9	5.0	0.3	0.5	0.8
Calcium	7440–70–2	500.0	50.0	4.6	55.4
Chromium	7440–47–3	10.0	0.5	0.9	1.2
Cobalt	7440–48–4	10.0	1.0	1.0	1.6
Copper	7440–50–8	20.0	0.7	1.0	2.2
Iron	7439–89–6	50.0	10.0	16.5	24.4
Lead	7439–92–1	5.0	0.3	1.6	2.6

Table 3.4
Zone J Storm Water Effluent Evaluation Addendum
Severn Trent Laboratories/Savannah Method Detection Limit Study for Metals by Low–Level Inductively Coupled Plasma (ICP) Method

		PQLs		MDLs	
Compound	**CAS Number**	**Water (μg/L)**	**Soil (mg/kg)**	**Water (μg/L)**	**Soil (mg/kg)**
Magnesium	7439–95–4	500.0	50.0	6.8	45.5
Manganese	7439–96–5	10.0	0.4	0.20	0.6
Nickel	7440–02–0	40	1.0	1.3	2.3
Potassium	7440–09–7	1000.0	100.0	20.0	148.0
Selenium	7782–49–2	10.0	0.5	3.5	3.3
Silver	7440–22–4	10.0	1.0	0.70	1.4
Sodium	7440–23–5	500.0	100.0	173.9	165.0
Thallium	7440–28–0	10.0	1.0	4.5	5.0
Tin	7440–31–5	50.0	5.0	4.2	16.2
Vanadium	7440–62–2	10.0	0.6	0.9	1.1
Zinc	744–66–6	20.0	2.0	1.0	4.2

Table 3.5
Zone J Storm Water Effluent Evaluation Addendum
Severn Trent Laboratories/Savannah Method Detection Limit Study for Mercury by Cold Vapors

		PQLs		MDLs	
Compound	**CAS Number**	**Water (μg/L)**	**Soil (mg/kg)**	**Water (μg/L)**	**Soil (mg/kg)**
Mercury by Cold Vapors **Test Code: MT310** **Method: SW846 Third Edition, Nov. 1986** **Matrix: Water–Soil** **Extract Volume: 100mL – 0.6g** **Initial Calibration: 0 – 10.0 μg/L** **Continuing Calibration: ½ high standard**					
Mercury	7439–97–6	0.20	0.033	0.10	0.008

Table 3.6
Zone J Storm Water Effluent Evaluation Addendum
Severn Trent Laboratories/Savannah Method Detection Limit Study for Miscellaneous Inorganics

		PQLs		MDLs	
Compound	**Method**	**Water (µg/L)**	**Soil (mg/kg)**	**Water (µg/L)**	**Soil (mg/kg)**
Miscellaneous Inorganic Analyses					
Test Code: **Methods various**					
Method:					
Matrix: **Water–Soil**					
Extract Volume:					
Initial Calibration:					
Continuing Calibration:					
Cyanide (Total)	SW846–9010	5.0	2.13	0.010	0.07

4.0 DRAINAGE BASIN EVALUATIONS

Section 4 summarizes the CNC drainage basins that discharge into the Cooper River. Seventy-two drainage basins discharge to the Cooper River; however, only 39 drainage basins containing upland SWMUs/AOCs and storm water drainage features were evaluated for storm water effluent contamination. Storm water effluent samples were collected from a variety of storm water drainage features which included manholes, catch basins and drainage ditches.

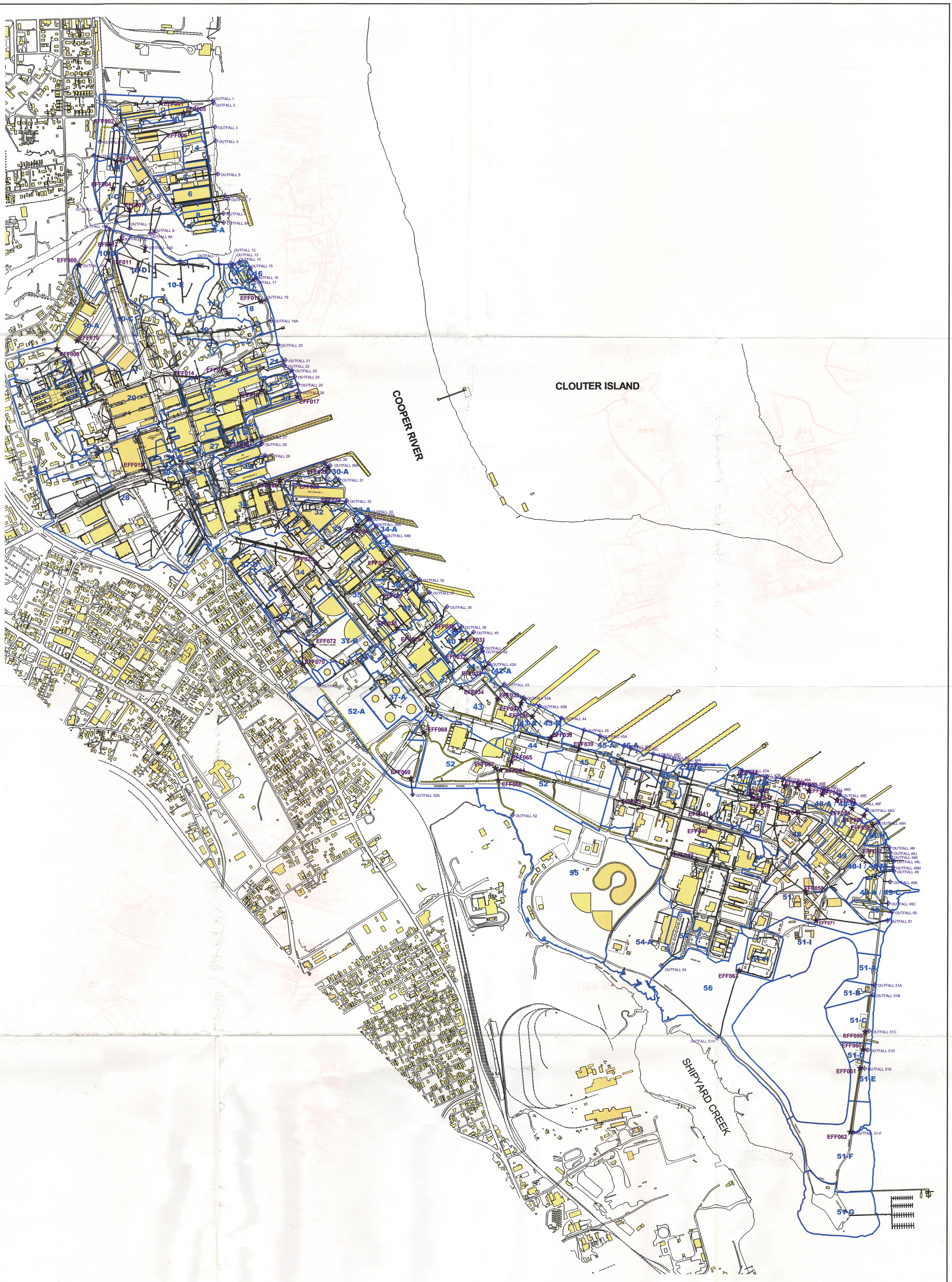
Based on risk management decisions, storm water effluent samples were compared to the Zone J screening criteria. Screening level criteria for surface soil and shallow groundwater samples were used to identify possible upland sources to establish a linkage with the effluent samples. The following table describes the order and type of screening criteria for each sample media for the pathway evaluations:

Table 4.0
Zone J Screening Criteria for Sample Media

Sediment/Surface Soil	Shallow Groundwater	Effluent Samples
1. Zone-specific Background (inorganics and selected poly aromatic hydrocarbons (PAHs) only)	1. Zone-specific Background (inorganics and selected PAHs only)	1. Reference Concentrations (inorganics)
2. Sediment Screening Values (SSV, USEPA Region IV)	2. Chronic Saltwater Water Quality Screening Values (USEPA Region IV)	2. Chronic Saltwater Water Quality Screening Values (USEPA Region IV)
	3. Acute Saltwater Water Quality Screening Values (USEPA Region IV)	3. Acute Saltwater Water Quality Screening Values (USEPA Region IV)
	4. MCLs for Groundwater	4. MCLs for Groundwater

4.1 Drainage Basin Evaluations for Cooper River

There are 72 drainage basins that discharge into Cooper River. Thirty nine of those 72 have upland SWMU/AOCs associated with them. Storm water effluent samples were collected from the 39 drainage basins to evaluate potential contaminants that may be discharging into the Cooper River. A total of 54 storm water effluent samples were collected to characterize those drainage basins. Table 4.1 summarizes the drainage basins associated with the Cooper River, and Figure 4-1 illustrates Cooper River drainage basins and outfalls.



Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-1
Cooper River Drainage Basins and Outfalls

November 2002 | Zone J Main Project.apr

Table 4.1
Cooper River Drainage Basins
Charleston Naval Complex, Charleston, South Carolina

Drainage Basin	Zone	SWMU/AOC	Storm Water Effluent Sample ID	Storm Water Location (Catch basin/Manhole)
1	A	2	EFF001	1-B
		38		
		39		
2	A	2	EFF005	2-A
3	A	2	CAP001	3-A
		504	EFF006	3-B
4	A	2	NR	NA
		506		
5	A	NL	NR	NA
6	A	NL	NR	NA
7	A	NL	NR	NA
8	A	NL	NR	NA
8A	A	37	NR	NA
15	B	NL	NR	NA
16	B	NL	NR	NA
17	B	NL	NR	NA
18	B	507	EFF013	18-A
19	B	NL	NR	NA
20	C	47	EFF014	20/5
		508		
		511		
		513		
		515		
		516		
		517		
		518		
		519		
	E	53		
		525		
		526		
21	E	54	NR	NA
		S21		
22	E	54	EFF015	22/6
		528		
		S21		
23	E	22	EFF016	23/2
		23		
		25		
		37		
		63		
		65		
		67		
		70		
		530		
		531		
		538		
		539		
		540		

Table 4.1
Cooper River Drainage Basins
Charleston Naval Complex, Charleston, South Carolina

Drainage Basin	Zone	SWMU/AOC	Storm Water Effluent Sample ID	Storm Water Location (Catch basin/Manhole)
		541		
		542		
		543		
		544		
		548		
		549		
		550		
		554		
24	E	NL	NR	NA
25	E	NL	NR	NA
26	E	65	EFF017	26-B
		550		
27	E	25	EFF018	27/1-A
		549		
		551		
		552		
		559		
28	C	520	EFF019	28/8
		522		
		523		
	E	559		
28A	E	170		
		171		
		559		
29	E	NL	NR	NA
30	E	83	EFF020	30/4
		84		
		87		
		145		
		170		
		171		
		172		
		173		
		559		
		560		
		561		
		562		
		563		
		564		
		566		
		567		
		569		
		570		
		572		
		573		
		574		
		576		
		578		

Table 4.1
Cooper River Drainage Basins
Charleston Naval Complex, Charleston, South Carolina

Drainage Basin	Zone	SWMU/AOC	Storm Water Effluent Sample ID	Storm Water Location (Catch basin/Manhole)
		579		
		580		
30A	E	567	EFF021	30A-A
30B	E	NL	NR	NA
30C	E	NL	NR	NA
31	E	566	EFF022	31/5
		567		
32	E	145	EFF023	32/2
		576		
		583		
33	E	37	EFF024	33/1
		97		
		586		
33A	E	NL	NR	NA
34	E	100	EFF025	34/5
		102		
		504		
	F	109		
		607		
		609		
34A	NONE	NL	NR	NA
34B	E	102	NR	NA
35	E	102	EFF026	35/1
		590		
		596		
	F	504		
		613		
36	E	596	EFF027	36/1
		598		
37	E	504	EFF028	37/3
	F	613	EFF072	37 LINE
37A	G	37		
		FDS		
37B	F	611		
	G	3		
		24		
		FDS		
37C	F	607		
		609		
		611		
		613		
37D	NONE	NL		
38	E	504	EFF029	38/4
		602		
		603		
	F	4		
		504		
		613		

Table 4.1
Cooper River Drainage Basins
Charleston Naval Complex, Charleston, South Carolina

Drainage Basin	Zone	SWMU/AOC	Storm Water Effluent Sample ID	Storm Water Location (Catch basin/Manhole)
		616		
		617		
		619		
		620		
	G	37		
		633		
		FDS		
39	E	106	EFF030	39/1-A
40	E	106	EFF031	40-B
		602		
		603		
41	E	5	EFF032	41-A
		18		
		604		
		605		
	F	36		
		620		
	G	FDS		
42	G	NL	NR	NA
42A	G	FDS	EFF033	42A-A
43	F	36	EFF034	43/3-C
		619	EFF035	Ditch near 43/2-A
		620		
	G	6		
		7		
		628		
		633		
		635		
		FDS		
43A	G	8	EFF036	43A-A
43B	G	120	EFF037	43A-F
		638		
		FDS		
44	G	8	EFF038	44-A1
		636		
		638		
		FDS		
45	G	642	EFF039	45/1
		643		
		FDS		
46	G	NL	NR	NA
44/46-A	G	37	NR	NA
		643		
		FDS		
46B	NONE	NL	NR	NA
47	H	13	EFF040	47/5/1A
		17	EFF041	47/4-D
		19	EFF042	47/5/4

Table 4.1
Cooper River Drainage Basins
Charleston Naval Complex, Charleston, South Carolina

Drainage Basin	Zone	SWMU/AOC	Storm Water Effluent Sample ID	Storm Water Location (Catch basin/Manhole)
		37	EFF043	47/8
		653		
		655		
		656		
		659		
		G07		
		G38		
		SGC		
	I	671		
		672		
		673		
47A	I	177	EFF044	47/A-A
		RTC		
47B	I	37	EFF045	47B-B
48	H	13	EFF046	48/1/1
		37	EFF047	48/1-A
		136	EFF048	48/3
		178		
		660		
		663		
		665		
		G80		
		SGC		
	I	679		
		RTC		
48/48-G	I	675	EFF049	48A-A1
		676	EFF050	48B-A1
		677	EFF051	48C-A
		678	EFF052	48D-A
		679	EFF053	48E-A
		680	EFF054	48F-A
		680	EFF055	48G-A
48H	I	681	EFF056	48H-A
48-I/48M	I	NL	NR	NA
		NL	NR	NA
		NL	NR	NA
		NL	NR	NA
		NL	NR	NA
49	H	37	EFF057	49/5
		666		
		G80		
	I	37		
		680		
		681		
49-A/49-C	NONE	NL	NR	NA
50	NONE	NL	NR	NA
51	H	17	EFF058	51/4
		138	EFF071	DITCH-51

Table 4.1
Cooper River Drainage Basins
Charleston Naval Complex, Charleston, South Carolina

Drainage Basin	Zone	SWMU/AOC	Storm Water Effluent Sample ID	Storm Water Location (Catch basin/Manhole)
		661		
		662		
		667		
51A	I	685	NR	NA
51B	I	NL	NR	NA
51C	I	687	EFF059	Ditch-51C
		DMA		
51D	I	688	NR	NA
51E	I	688	NR	NA
51F	I	12	NR	NA
		690		
		DMA		
51G	I	690	NR	NA
51I	H	14	NR	NA
		15		
		37		
		670		
		684		
	I	684		
		685		
		DMA		
53	F	611	EFF070	53
		FDS		
	G	FDS		
Clouter Island	K	Clouter	NR	NA

Notes:
DMA = Dredge Material Area
FDS = Fuel Distribution System
NL = No Listed SWMU/AOC
NR = Not Required according to the *Zone J Point of Entry Work Plan*
RTC = Reserve Training Center
SGC = Soil Gas Confirmation

4.2 Drainage Basin 1

Drainage Basin 1 encompasses approximately seven acres within Zone A in the northern section of the CNC. Land cover within the drainage basin consists of approximately 70% unpaved surfaces (i.e., mostly gravel), 10% paved surfaces and 20% buildings. Storm water runoff within the drainage basin is directed to at least one of eight catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 1.

Figure 4-2 illustrates the area encompassing Drainage Basin 1 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.2.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are three SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 1. The sites and their current RFI status are listed in Table 4.2.1. These sites include SWMU 2 (Lead Contamination Area), SWMU 38 (Miscellaneous Storage), and SWMU 39 (Petroleum, Oil, and Lubricant (POL) Drum Storage). For this drainage basin assessment the majority of SWMU 2 resides in Drainage Basins 2 and 3 with only a small portion transcending the northeast boundary of Drainage Basin 1.

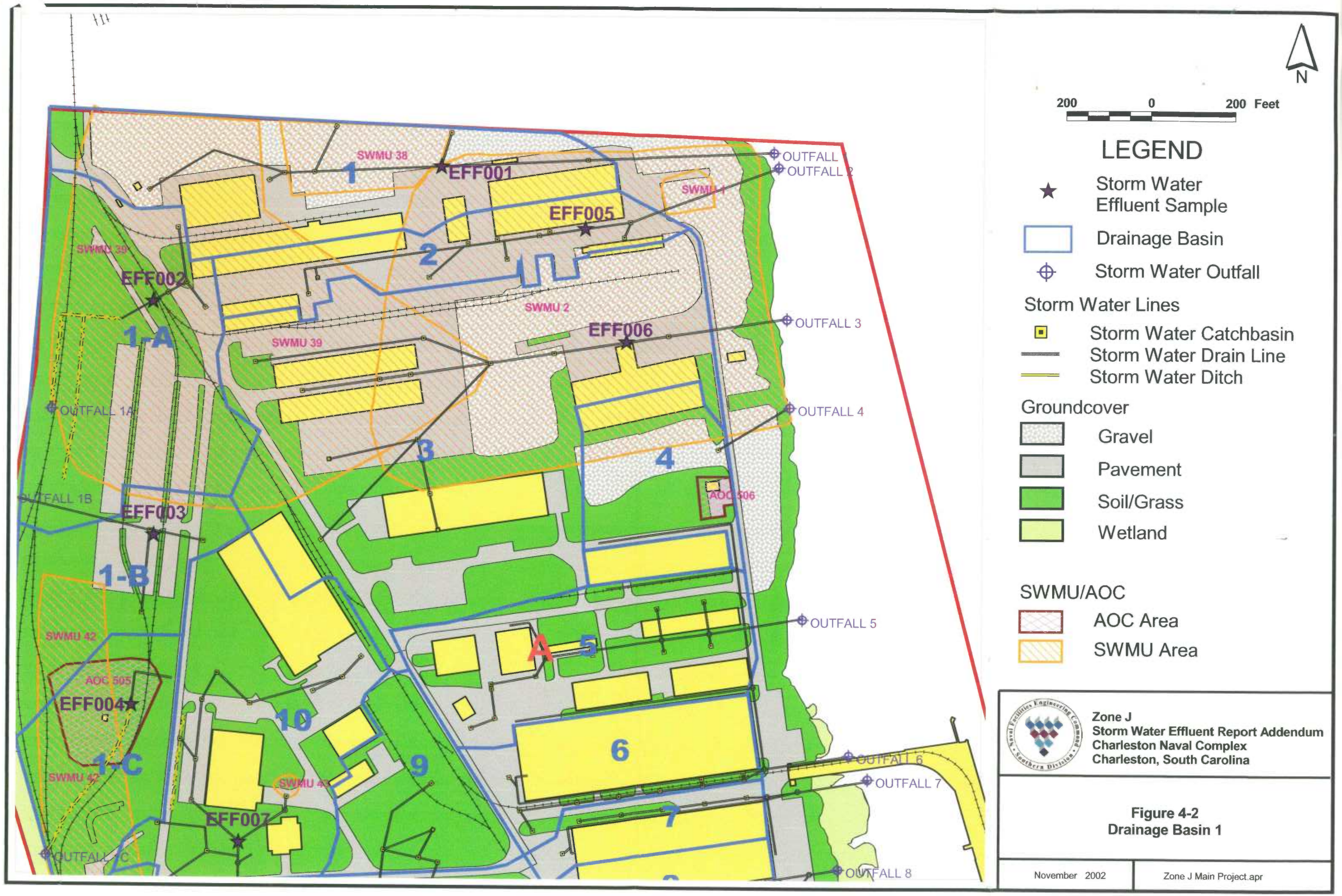
Table 4.2.1
Drainage Basin 1 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 2	Lead Contamination Area	RFI; IM complete; CMS complete; No further action (NFA)
SWMU 38	Miscellaneous Storage	RFI Complete, Interim Measure (IM) Complete, CMS ongoing
SWMU 39	POL Drum Storage	RFI Complete, CMS ongoing

4.2.1.1 SWMU 2

Site Description and History

SWMU 2 consists of salvage bin No. 3 and the adjacent paved ground surface at the Defense Reutilization Marketing Office (DRMO) facility. The area was used to store recovered lead from lead-acid submarine batteries from the mid-1960s until 1984. Electrodes and associated



Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-2
Drainage Basin 1

November 2002 | Zone J Main Project.apr

internal metallic components were removed from the battery jars in the battery electrode treatment area at SWMU 5 in Zone E. Recovered materials were then placed on a railcar and transferred to the DRMO area for storage and eventual sale to a salvage contractor. The site had been designated for an RFI because of the historical lead concentrations in surrounding media and extensive sampling has been conducted at SWMU 2 from 1986 to 2002. Due to possible contaminant migration via surface water runoff from Hurricane Hugo in 1989, the investigation area for SWMU 2 had been expanded to cover a larger area, which also included SWMU 1.

Soil was sampled in 1986 from the DRMO site and in 1993 samples were collected to investigate soil and groundwater near SWMU2 to determine if Hurricane Hugo impacted the lead distribution onsite in 1989. Additionally, 11 sediment samples were collected from the Cooper River and storm sewer system in the vicinity. Two of the sediment samples were collected from catch basins within the boundaries of Drainage Basin 1. The RFI, conducted between October 1995 and January 1997, revealed elevated lead levels in the soil above clean levels established by the BCT. Based on RFI analytical results and the risk assessment, several COCs requiring further evaluation through the CMS process were identified for surface soil and shallow groundwater. An IM was performed to remove lead-contaminated soils and concrete after the RFI was complete.

Previous Investigations

A summary of investigative activities performed at SWMU 2 is presented in Table 4.2.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results for RFI activities prior to 2000 are presented in the *Final Zone A RFI Report* (EnSafe, 1998).

Table 4.2.2
Summary of SWMU 2 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
Final Contamination	October 1986	Soil samples were collected for screening purposes.

Table 4.2.2
Summary of SWMU 2 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
and Exposure Assessment for lead Contamination within the DRMO (Environmental Science and engineering)		***Round 1*** **Soil:** 45 surface borings (0 to 0.5 feet) 10 subsurface borings (26 samples collected at various intervals) (SS-1 – SS-35, B1 – B10): Lead	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
1993 sampling event E/A&H	1993	After Hurricane Hugo impacted the lead distribution onsite in 1989, soil, groundwater, and sediment samples were collected in 1993 to determine the impact around SWMU 2.	
		Round 1 **Soil:** 22 surface borings (0 to 1 foot) 20 subsurface borings (3 to 5 feet) (S02SB001 – S02SB023): metals and cyanide (3 duplicates collected for same parameters) **Sediment:** 11 sediments collected; 4 of those were collected from catch basins (S02M0001 – S02M0004): metals and cyanide	***Round 1*** **Groundwater:** 6 shallow wells (Charleston Naval Shipyard [CNSY]0201 – CNSY0206): metals and cyanide (2 duplicates collected for same parameters)
Final Zones A and B RFI (EnSafe)	1995-1997	Site soil and groundwater investigation	
		Round 1 **Soil:** 24 surface borings (0 to 1 foot) 20 subsurface borings (3 to 5 feet) (002SB001 – 002SB015; 002SB019; 002SB023 – 002SB030): metals (6 duplicates collected for herbicides, hexavalent chromium, organophosphate [OP] pesticides, and metals)	***Round 1*** **Groundwater:** 6 shallow wells (002001 – 002006): metals
Final Zones A and B RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** 16 surface borings (0 to 1 foot) 14 subsurface borings (3 to 5 feet) (002SB016 – 002SB018; 002SB020 – 002SB022; 002SB031 – 002SB041): metals (3 duplicates collected for same parameters and/or herbicides,	***Round 2*** **Groundwater:** 6 shallow wells (002001 – 002006): metals

Table 4.2.2
Summary of SWMU 2 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		hexavalent chromium, OP pesticides, and metals)	
Final Zones A and B RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 6 shallow wells (002001 – 002006): metals
Final Zones A and B RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 5 shallow wells (002001 – 002004; 002006): metals, Total Dissolved Solids (TDS), chloride, and sulfate
CMS (EnSafe)	1998-1999	Soil and shallow groundwater investigation	
		Round 1 **Soil:** 34 surface borings (0 to 1 foot) (002SBC01 – 002SBC04): Total Lead (002SBC011A – 002SBC41A): Synthetic Precipitation Leaching Procedure (SPLP) metals (002SBC011B – 002SBC041B): Toxicity Characteristic Leachate Procedure (TCLP) metals	***Round 1*** **Groundwater:** 5 shallow wells (002002, 002003, 002007, and 002008): chloride, metals, and TDS (002004): chloride, metals, pesticides, and TDS
IM	1999	Soil investigation Report states that 19 samples were actually samples for TCLP Total Lead	
CH2M-Jones	2002	Groundwater investigation	
		Round 1 **Soil:** No Soil Sample Collected.	***Round 1*** **Groundwater:** 1 shallow well (002004): Volatile Organic Compound (VOC)

Nature and Extent of Contaminants

Approximately 175 sample locations associated with SWMU 2 were evaluated for the presence of contaminants between 1986 and 2002. Of these 175, approximately 11 locations are within the boundaries of Drainage Basin 1. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. During the RFI, arsenic, beryllium, and lead in soil and lead

in groundwater were identified as COPCs. Detections of lead in groundwater occurred in only one (002005) of six wells and were determined to be attributed to high lead concentrations in the surrounding soil. Given that lead was not detected in any of the other monitoring wells onsite, indicating contamination migration was not occurring, groundwater was not considered an immediate concern at the site. Based on the analytical results and the human health risk assessment for the combined site, a CMS was recommended for both soil and shallow groundwater at SWMU 2. Based on the analytes detected and the overall surface flow in the area, it was also recommended that the CMS investigation include SWMU 1.

4.2.1.2 SWMU 38

Site Description and History

SWMU 38 is the site where a former storage yard was associated with Buildings 1605 and 1604 for approximately 50 years. The gravel storage area, bordered by a chain-link fence, originally belonged to the supply department and later became part of DRMO, which used the area for storage of empty drums. The site is north of Building 1605, near the northern boundary of CNC which borders the Hess Oil Inc. tank farm, and because of possible concerns from petroleum constituents migrating on site, the scope of the investigation included assessment of potential petroleum releases from offsite.

Previous Investigations

A summary of investigative activities performed at SWMU 38 is presented in Table 4.2.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results of RFI activities prior to 2000 are presented in the *Final Zone A RFI Report* (EnSafe, 1998).

Table 4.2.3
Summary of SWMU 38 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation

Table 4.2.3
Summary of SWMU 38 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		Round 1 **Soil:** 6 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (038SB001 – 038SB006): VOCs, SVOCs, metals, pesticides/PCBs, and Total Petroleum Hydrocarbons (TPH) (2 duplicates collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins)	***Round 1*** **Groundwater:** 2 shallow wells (038001, 038002): VOCs, SVOCs, metals, pesticides/PCBs, TPH
RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (038SB007 – 038SB010): Pesticides/PCBs (1 duplicate collected for same parameters)	***Round 2*** **Groundwater:** 2 shallow wells (038001, 038002): metals, pesticides/PCBs;
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** 4 surface borings (0 to 1 foot) (038SB011 – 038SB014): Pesticides/PCBs	***Round 3*** **Groundwater:** 2 shallow wells (038001, 038002): metals, pesticides/PCBs, TDS, sulfate, chloride
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (038001, 038002): metals, pesticides/PCBs, TDS, sulfate, chloride
CMS (EnSafe)	1998-1999	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 1 shallow well (038003): metals, pesticides/PCBs, TDS, chloride
CMS (EnSafe)	1998-1999	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (038003): Pesticides/PCBs
CH2M-Jones	2001-2002	Soil and groundwater investigation	
	2001	***Round 1*** **Soil:** 3 surface borings (0 to 1 foot) (038SB015, 038SB016): PCBs (038SB017): Pesticides	***Round 1*** **Groundwater:** 1 shallow well (038001): Pesticides
CH2M-Jones	2001	***Round 2*** **Soil:**	***Round 2*** **Groundwater:**

Table 4.2.3
Summary of SWMU 38 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		1 surface boring (0 to 1 foot) (038SB023): Pesticides/PCBs 5 subsurface borings (3 to 5 feet) (038SB018 – 038SB022): Pesticides	No Groundwater Samples Collected.
CH2M-Jones	2002	***Round 3*** **Soil:** 3 surface borings (0 to 1 foot) (038SB024 – 038SB026): PCBs	***Round 3*** **Groundwater:** No Groundwater Samples Collected.
CH2M-Jones	2002	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 4 shallow wells (038001): VOCs (038003 – 038005): VOCs, pesticides
CH2M-Jones	2002	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (038001): Pesticides
CH2M-Jones	2002	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 4 shallow wells (038001, 038003 – 038005): VOCs, SVOCs, pesticides

Nature and Extent of Contaminants

Approximately 30 sample locations associated with SWMU 38 were evaluated for the presence of contaminants between 1995 and 2002. All sample locations are within the boundaries of Drainage Basin 1. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. During the RFI aluminum, arsenic, Aroclor-1260, 4,4'-Dichlorodiphenyldichloroethane (DDD), 4,4'-1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene (DDE), 4,4'-Dicholoro-Diphenyl-Trichlorethane (DDT), and TPH in soil; and 4,4'-DDD, 4,4'-DDT, and thallium in shallow groundwater were identified as COPCs. Based on the analytical results and the human health risk assessment for the site, a CMS was recommended for both soil and shallow groundwater at SWMU 38.

4.2.1.3 SWMU 39

Site Description and History

SWMU 39 refers to a former POL drum storage area situated north of Building 1604, near the northern boundary of CNC. Currently, the portion of the site adjacent to Building 1604 is paved, while the portion that continues north to the property boundary is gravel–covered. Due to the close proximity of the Hess Oil Inc. tank farm to the property boundary, the potential for petroleum releases from offsite sources to impact CNC property was included in the scope of the site investigation.

Previous Investigations

A summary of investigative activities performed at SWMU 39 is presented in Table 4.2.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results for RFI activities prior to 2000 are presented in the *Final Zone A RFI Report* (EnSafe, 1998).

Table 4.2.4
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation	
		Round 1 **Soil:** 15 surface borings (0 to 1 foot) 15 subsurface borings (3 to 5 feet) (039SB001 – 039SB015): VOCs, SVOCs, metals, pesticides/PCBs, and TPH (2 duplicates collected for same parameters plus herbicides, cyanide, hexavalent chromium, OP pesticides, and dioxins)	***Round 1*** **Groundwater:** 5 shallow wells (039001 - 039005): VOCs, SVOCs, metals, pesticides/PCBs, TPH (1duplicate collected for same parameters plus herbicides, cyanide, OP pesticides, chloride, sulfate, dioxins, hexavalent chromium, and TDS)
RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** 25 surface borings (0 to 1 foot) 25 subsurface borings (3 to 5 feet) (039SB016 – 039SB018, 039SB020, and 039SB025): TPH and pesticides/PCBs	***Round 2*** **Groundwater:** 5 shallow wells (039001 - 039005): VOCs

Table 4.2.4
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		(039SB022 – 039SB024, and 039SB038): TPH and SVOCs (039SB019, 039SB021, 039SB026 – 039SB037, and 039SB039 – 039SB040): TPH (1 duplicate collected for same parameters plus herbicides, cyanide, hexavalent chromium, OP pesticides, and dioxins)	
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (039SB041 – 039SB043): VOCs	***Round 3*** **Groundwater:** 5 shallow wells (039001 - 039005): VOCs, SVOCs, metals, and hexavalent chromium (1 duplicate collected for same parameters plus cyanide and dioxins)
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 5 shallow wells (039001 - 039003,): VOCs, SVOCs, metals, chloride, sulfate, hexavalent chromium, and TDS (039004 and 039005): VOCs, SVOCs, metals, chloride, sulfate, hexavalent chromium, dioxins, and TDS (1duplicate collected for same parameters)
RFI (EnSafe)	1995-1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 10 additional wells installed and sampled (1996)-of which there were 7 shallow wells: 7 shallow wells (039006 - 039012): VOCs
RFI (EnSafe)	1995-1997	***Round 6*** **Soil:** 1 biased sample (039SB10I02): VOCS and SVOCs	***Round 6*** **Groundwater:** 7 additional wells installed and sampled (1996)
RFI (EnSafe)	1995-1997	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 12 shallow wells (039001, 039002): VOCs, SVOCs, metals, chloride, sulfate, hexavalent chromium, dioxins, and TDS

Table 4.2.4
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			(039003): VOCs, SVOCs, metals, chloride, sulfate and TDS (039004): VOCs, SVOCs, metals, chloride, sulfate dioxins, and TDS (039005): VOCs, SVOCs, metals, chloride, sulfate, pesticides/PCBs, cyanide, dioxins, and TPH (039006 - 039012): VOCs, SVOCs, metals, chloride, sulfate, dioxins, and TDS (2 duplicates collected for VOCs, SVOCs, chloride, sulfate, metals, dioxins, and TDS)
RFI (EnSafe)	1995-1997	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** 5 additional wells installed and sampled (1997)- of which there were 3 shallow wells. 3 shallow wells (039013 - 039015): VOCs, SVOCs, metals, pesticides/PCBs, and cyanide
RFI (EnSafe)	1995-1997	***Round 10*** **Soil:** No Soil Samples Collected.	***Round 10*** **Groundwater:** 7 shallow wells (039008 - 039010, 039012, and 039013): VOCs, SVOCs, metals, chloride, sulfate, dioxins, TDS, and TPH (039014 and 039015): VOCs, SVOCs, alkalinity, ammonia, chloride, cyanide, ferrous iron, nitrate, phosphorous, sulfate, sulfide, BOD, metals, and pesticides/PCBs (1 duplicate collected for VOCs, SVOCs, chloride, sulfate, dioxins, metals, TDS, and TPH)
RFI (EnSafe)	1995-1997	***Round 11*** **Soil:** No Soil Samples Collected.	***Round 11*** **Groundwater:** 10 shallow wells (039006 - 039015): VOCs and SVOCs (2 duplicates collected for same parameters)
RFI (EnSafe)	1995-1997	***Round 12*** **Soil:** No Soil Samples Collected.	***Round 12*** **Groundwater:** 10 shallow wells

Table 4.2.4
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			(039006 - 039015): VOCs, SVOCs, and metals (1 duplicate for same parameters)
MNA (EnSafe)	1998-1999	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 15 shallow wells (039001 - 039015): VOCs, TOC, and sulfate
MNA (EnSafe)	1998-1999	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 14 shallow wells (039001 - 039014): VOCs, Total Kjeldahl Nitrogen (TKN), TOC, nitrate, phosphorous, sulfate, and sulfide 12 additional wells installed and sampled (1998)- of which there were 4 shallow wells 4 shallow wells (039016 - 039019): VOCs, TKN, TOC, nitrate, phosphorous, sulfate, and sulfide
MNA (EnSafe)	1998-1999	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** **Confirmatory Sampling** 5 shallow wells (039009, 039016 - 039019): VOCs 6 additional wells installed and sampled (1999)- of which there were 2 shallow wells 2 shallow wells (039020 and 039021): VOCs
MNA (EnSafe)	1998-1999	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 19 shallow wells (039001 - 039014, 039016, 039018 - 039021): VOCs, TOC, alkalinity, iron, sulfate, nitrate, and sulfide
CMS (EnSafe)	1998-1999	***Round 1*** **Soil:** 15 surface borings (0 to 1 foot) (039SB047 – 039SB061): VOCs, SVOCs, and metals (1 duplicate collected for same parameters)	***Round 1*** **Groundwater:** 19 shallow wells (039001 - 039019): chloride, metals, and TDS (2 duplicates collected for same parameters)

Table 4.2.4
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CMS (EnSafe)	1998-1999	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 multi-level well installed and sampled (1999) (039024 M): VOCs
CH2M-Jones	2001-2002	Groundwater investigation	
	2001	***Round 1*** **Soil:** No Soil Samples Collected	***Round 1*** **Groundwater:** 2 shallow wells (039012 – 039013): VOCs, metals, general chemistry, Methane (CH4)/Carbon Dioxide (CO2)
CH2M-Jones	2001	***Round 2*** **Soil:** No Soil Samples Collected	***Round 2*** **Groundwater:** 2 shallow wells (039012 – 039013): metals, general chemistry, CH4/CO2
CH2M-Jones	2001	***Round 3*** **Soil:** No Soil Samples Collected	***Round 3*** **Groundwater:** 2 shallow wells (039012 – 039013): VOCs, metals, general chemistry, CH4/CO2
CH2M-Jones	2001	***Round 4*** **Soil:** No Soil Samples Collected	***Round 4*** **Groundwater:** 2 shallow wells (039012 – 039013): VOCs, metals, general chemistry, CH4/CO2
CH2M-Jones	2002	***Round 5*** **Soil:** No Soil Samples Collected	***Round 5*** **Groundwater:** 2 shallow wells (039012 – 039013): VOCs, metals, general chemistry, CH4/CO2
CH2M-Jones	2002	***Round 6*** **Soil:** No Soil Samples Collected	***Round 6*** **Groundwater:** (039006 – 039007): VOCs

Nature and Extent of Contaminants

Approximately 81 sample locations associated with SWMU 39 were evaluated for the presence of contaminants between 1995 and 2002. Of these 81, approximately 65 sample locations are within the boundaries of Drainage Basin 1. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of

potential contamination at the site. During the RFI benzo(a)pyrene Equivalent Quotients (BEQs), beryllium and Arochlor 1260 in soil; and VOCs and inorganics in groundwater were identified as COPCs.

4.2.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at catch basin 1-B on February 7, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 1 into the Cooper River. Analytical detections for sample EFF001 are presented in Table 4.2.5.

Table 4.2.5
Storm Water Effluent Sampling Results
Drainage Basin 1

					Screening Value (µg/L)		
Drainage Basin	**Catch Basin/ Manhole ID**	**Sample ID**	**Parameter**	**Concentration (µg/L)**	**Reference Concentration**	**Chronic Saltwater Screening Value**	**Potential COPC**
1	1-B	EFF001	Aluminum	200	3,277	NL	No
			Barium	19	60.13	NL	No
			Calcium*	29,000	53,455	NL	No
			Chromium	1.20	13	50	No
			Iron	440	4,134	NL	No
			Lead	4.50	33.63	8.50	No
			Magnesium*	1,200	49,255	NL	No
			Manganese	14	74.52	NL	No
			Potassium*	1,100	23,678	NL	No
			Sodium*	3,100	395,333	NL	No
			Vanadium	2.60	15.59	NL	No
			Zinc	150	307.83	86	No

Notes:
NL = Not Listed
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.2.3 Pathway Evaluation

There were no potential storm water effluent COPCs identified for Drainage Basin 1 that require further characterization; therefore, contaminant migration pathway scenarios (1a through 1d) do not require further evaluation.

4.3 Drainage Basin 2

Drainage Basin 2 encompasses approximately 3.5 acres within Zone A in the northern section of the CNC. Land cover within the basin consists of approximately 60% paved surfaces and 40% covered by building foundations. All storm water runoff within the drainage basin is directed to at least one of the 10 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 2.

Figure 4-3 illustrates the area encompassing Drainage Basin 2 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.3.1 Potential Source Areas

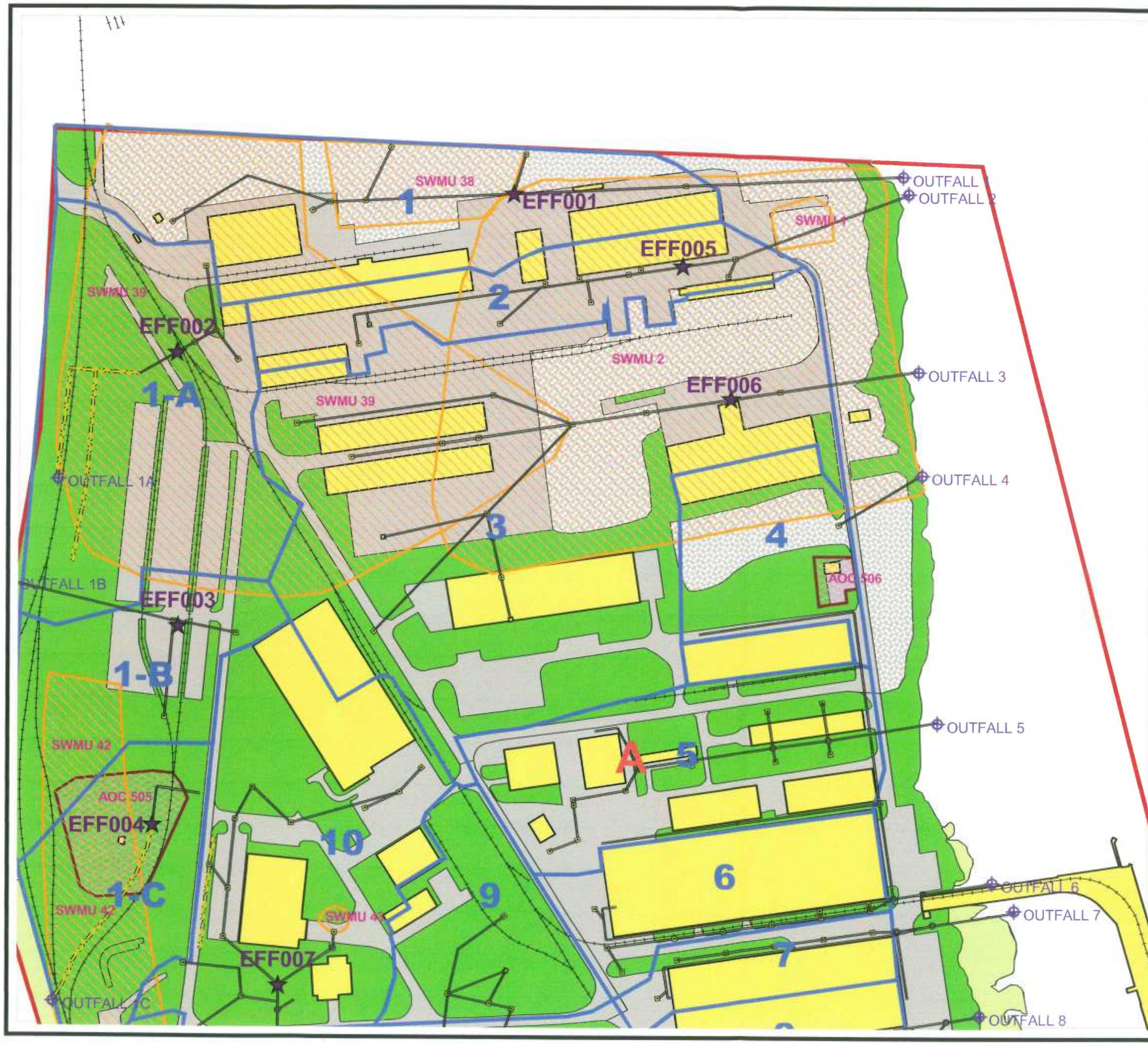
A review of the listings of sites found in Appendix A of the Part B Permit indicates there are two SWMUs/AOCs within the boundary of Drainage Basin 2. The sites, SWMU 2 (Lead Contamination Area) and SWMU 39 (POL Drum Storage), are listed in Table 4.3.1 with the current status of the site. The boundary of SWMU 2 transcends the boundary of Drainage Basin 2 along the west side where it extends into Drainage Basin 1-A to the north into Drainage Basin 1, and also to the south where it crosses into Drainage Basin 3. The majority of SWMU 39 resides in Drainage Basins 1 and 1-A; however, one sample location is within the boundaries of Drainage Basin 2.

Table 4.3.1
Drainage Basin 2 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 2	Lead Contamination Area	RFI; IM complete; CMS complete; NFA
SWMU 39	POL Drum Storage	RFI Complete, CMS ongoing

4.3.1.1 SWMU 2
Site Description and History

SWMU 2 consists of salvage bin No. 3 and the adjacent paved ground surface at the DRMO facility. The area was used to store recovered lead from lead-acid submarine batteries from the mid-1960s until 1984. Electrodes and associated internal metallic components were removed



N

200 0 200 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Naval Facilities Engineering Command Southern Division

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-3
Drainage Basin 2

November 2002	Zone J Main Project.apr

from the battery jars in the battery electrode treatment area at SWMU 5 in Zone E. Recovered materials were then placed on a railcar and transferred to the DRMO area for storage and eventual sale to a salvage contractor. The site had been designated for an RFI because of the historical lead concentrations in surrounding media and extensive sampling has been conducted at SWMU 2 from 1986 to 2002. Due to possible contaminant migration via surface water runoff from Hurricane Hugo in 1989, the investigation area for SWMU 2 had been expanded to cover a larger area, which also includes SWMU 1.

Soil was sampled in 1986 from the DRO site and in 1993 samples were collected to investigate soil and groundwater near SWMU 2 after Hurricane Hugo impacted the lead distribution onsite in 1989. Additionally, 11 sediment samples were collected from the Cooper River and storm sewer system in the vicinity. Two of the sediment samples were collected from catch basins within the boundaries of Drainage Basin 2. The RFI, conducted between October 1995 and January 1997, revealed elevated lead levels in the soil above clean levels established by CNC. Based on RFI analytical results and the risk assessment, several chemicals of concern (COCs) requiring further evaluation through the CMS process were identified for surface soil and shallow groundwater. An IM was performed in 1999 to remove lead-contaminated soils and concrete after the RFI was complete.

Previous Investigations

A summary of investigative activities performed at SWMU 2 is presented in Table 4.3.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results for RFI activities prior to 2000 are presented in the *Final Zone A RFI Report.*

Table 4.3.2
Summary of SWMU 2 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
Final Contamination and Exposure	October 1986	Soil samples were collected for screening purposes.

Table 4.3.2
Summary of SWMU 2 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Assessment for lead Contamination within the DRMO (Environmental Science and engineering)		***Round 1*** **Soil:** 45 surface borings (0 to 0.5 feet) 10 subsurface borings (26 samples collected at various intervals) (SS-1 – SS-35, B1 – B10): Lead	**Round 1** **Groundwater:** No Groundwater Samples Collected.
1993 sampling event E/A&H	1993	After Hurricane Hugo impacted the lead distribution onsite in 1989, soil, groundwater, and sediment samples were collected in 1993 to determine the impact around SWMU 2.	
		Round 1 **Soil:** 22 surface borings (0 to 1 foot) 20 subsurface borings (3 to 5 feet) (S02SB001 – S02SB023): metals and cyanide (3 duplicates collected for same parameters) **Sediment:** 11 sediments collected; 4 of those were collected from catch basins (S02M0001 – S02M0004): metals and cyanide	***Round 1*** **Groundwater:** 6 shallow wells (CNSY0201 – CNSY0206): metals and cyanide (2 duplicates collected for same parameters)
Final Zones A and B RFI (EnSafe)	1995-1997	Site soil and groundwater investigation	
		Round 1 **Soil:** 24 surface borings (0 to 1 foot) 20 subsurface borings (3 to 5 feet) (002SB001 – 002SB015; 002SB019; 002SB023 – 002SB030): metals (6 duplicates collected for herbicides, hexavalent chromium, OP pesticides, and metals)	**Round 1** **Groundwater:** 6 shallow wells (002001 – 002006): metals
Final Zones A and B RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** 16 surface borings (0 to 1 foot) 14 subsurface borings (3 to 5 feet) (002SB016 – 002SB018; 002SB020 – 002SB022; 002SB031 – 002SB041): metals (3 duplicates collected for same parameters and/or herbicides, hexavalent chromium, OP pesticides, and metals)	**Round 2** **Groundwater:** 6 shallow wells (002001 – 002006): metals
Final Zones A and	1995-1997	***Round 3***	**Round 3**

Table 4.3.2
Summary of SWMU 2 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
B RFI (EnSafe)		**Soil:** No Soil Samples Collected.	**Groundwater:** 6 shallow wells (002001 – 002006): metals
Final Zones A and B RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	**Round 4** **Groundwater:** 5 shallow wells (002001 – 002004; 002006): metals, TDS, chloride, and sulfate
CMS (EnSafe)	1998-1999	Soil and shallow groundwater investigation ***Round 1*** **Soil:** 34 surface borings (0 to 1 foot) (002SBC01 – 002SBC04): Total Lead (002SBC011A – 002SBC41A): SPLP metals 30 subsurface borings (3 to5 feet) (002SBC011B – 002SBC041B): TCLP metals	**Round 1** **Groundwater:** 5 shallow wells (002002, 002003, 002007, and 002008): chloride, metals, and TDS (002004): chloride, metals, pesticides, and TDS
IM	1999	Soil investigation Report states that 19 samples were actually samples for TCLP Total Lead	
CH2M-Jones	2002	Groundwater investigation ***Round 1*** **Soil:** No Soil Sample Collected.	***Round 1*** **Groundwater:** 1 shallow well (002004): VOC

Nature and Extent of Contaminants

Approximately 175 sample locations associated with SWMU 2 were evaluated for the presence of contaminants between 1986 and 2002. Of these 175, approximately 18 locations are within the boundaries of Drainage Basin 2. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. During the RFI arsenic, beryllium, and lead in soil and lead in groundwater were identified as COPCs. Detections of lead in groundwater occurred in only one (002005) of six wells and were determined to be attributed to high lead concentrations in the surrounding soil. Given that lead was not detected in any of the other monitoring wells onsite,

indicating contamination migration was not occurring, groundwater was not considered an immediate concern at the site. Based on the analytical results and the human health risk assessment for the combined site, a CMS was recommended for both soil and shallow groundwater at SWMU 2. Based on the analytes detected and the overall surface flow in the area, it was also recommended that the CMS investigation include SWMU 1.

4.3.1.2 SWMU 39

Site Description and History

SWMU 39 refers to a former POL drum storage area situated north of Building 1604, near the northern boundary of the CNC. That portion of the site adjoining the south, east, and west sides of Building 1604 is paved, while the portion that continues north to the property boundary is gravel–covered. The potential for petroleum releases from offsite sources to impact the CNC property was included in the scope of the site investigation due to the close proximity of the Hess Oil Inc. tank farm to the property boundary.

Previous Investigations

A summary of investigative activities performed at SWMU 39 is presented in Table 4.3.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results of RFI activities prior to 2000 are presented in the *Final Zone A RFI Report*.

Table 4.3.3
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation.	
		Round 1 **Soil:** 15 surface borings (0 to 1 foot) 15 subsurface borings (3 to 5 feet) (039SB001 – 039SB015): VOCs, SVOCs, metals, pesticides/PCBs, and TPH	***Round 1*** **Groundwater:** 5 shallow wells (039001 - 039005): VOCs, SVOCs, metals, pesticides/PCBs, TPH (1 duplicate collected for same

Table 4.3.3
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		(2 duplicates collected for same parameters plus herbicides, cyanide, hexavalent chromium, OP pesticides, and dioxins)	parameters plus herbicides, cyanide, OP pesticides, chloride, sulfate, dioxins, hexavalent chromium, and TDS)
RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** 25 surface borings (0 to 1 foot) 25 subsurface borings (3 to 5 feet) (039SB016 – 039SB018, 039SB020, and 039SB025): TPH and pesticides/PCBs (039SB022 – 039SB024, and 039SB038): TPH and SVOCs (039SB019, 039SB021, 039SB026 – 039SB037, and 039SB039 – 039SB040): TPH (1 duplicate collected for same parameters plus herbicides, cyanide, hexavalent chromium, OP pesticides, and dioxins)	***Round 2*** **Groundwater:** 5 shallow wells (039001 - 039005): VOCs
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (039SB041 – 039SB043): VOCs	***Round 3*** **Groundwater:** 5 shallow wells (039001 - 039005): VOCs, SVOCs, metals, and hexavalent chromium (1 duplicate collected for same parameters plus cyanide and dioxins)
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 5 shallow wells (039001 - 039003,): VOCs, SVOCs, metals, chloride, sulfate, hexavalent chromium, and TDS (039004 and 039005): VOCs, SVOCs, metals, chloride, sulfate, hexavalent chromium, dioxins, and TDS (1duplicate collected for same parameters)
RFI (EnSafe)	1995-1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 10 additional wells installed and sampled (1996) of which there were 7 shallow wells (039006 - 039012): VOCs
RFI (EnSafe)	1995-1997	***Round 6*** **Soil:**	***Round 6*** **Groundwater:**

Table 4.3.3
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		1 biased sample (039SB10I02): VOCS and SVOCs	No Groundwater Samples Collected.
RFI (EnSafe)	1995-1997	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 12 shallow wells (039001, 039002): VOCs, SVOCs, metals, chloride, sulfate, hexavalent chromium, dioxins, and TDS (039003): VOCs, SVOCs, metals, chloride, sulfate and TDS (039004): VOCs, SVOCs, metals, chloride, sulfate dioxins, and TDS (039005): VOCs, SVOCs, metals, chloride, sulfate, pesticides/PCBs, cyanide, dioxins, and TPH (039006 - 039012): VOCs, SVOCs, metals, chloride, sulfate, dioxins, and TDS (2 duplicates collected for VOCs, SVOCs, chloride, sulfate, metals, dioxins, and TDS)
RFI (EnSafe)	1995-1997	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1995-1997	***Round 9*** **Soil:** No Soil Samples Collected.	***Round 9*** **Groundwater:** 3 shallow wells (039013 - 039015): VOCs, SVOCs, metals, pesticides/PCBs, and cyanide
RFI (EnSafe)	1995-1997	***Round 10*** **Soil:** No Soil Samples Collected.	***Round 10*** **Groundwater:** 7 shallow wells (039008 - 039010, 039012, and 039013): VOCs, SVOCs, metals, chloride, sulfate, dioxins, TDS, and TPH (039014 and 039015): VOCs, SVOCs, alkalinity, ammonia, chloride, cyanide, ferrous iron, nitrate, phosphorous, sulfate, sulfide, BOD, metals, and pesticides/PCBs (1 duplicate collected for VOCs, SVOCs, chloride, sulfate, dioxins, metals, TDS, and TPH)

Table 4.3.3
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	***Round 11*** **Soil:** No Soil Samples Collected.	***Round 11*** **Groundwater:** 10 shallow wells (039006 - 039015): VOCs and SVOCs (2 duplicates collected for same parameters)
RFI (EnSafe)	1995-1997	***Round 12*** **Soil:** No Soil Samples Collected.	***Round 12*** **Groundwater:** 10 shallow wells (039006 - 039015): VOCs, SVOCs, and metals (1 duplicate for same parameters)
MNA (EnSafe)	1998-1999	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 15 shallow wells (039001 - 039015): VOCs, TOC, and sulfate
MNA (EnSafe)	1998-1999	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 14 shallow wells (039001 - 039014): VOCs, TKN, TOC, nitrate, phosphorous, sulfate, and sulfide 12 additional wells installed and sampled (1998) of which there were 4 shallow wells (039016 - 039019): VOCs, TKN, TOC, nitrate, phosphorous, sulfate, and sulfide (***MNA Round 2 Confirmatory Sampling***): 5 shallow wells (039009, 039016 - 039019): VOCs 6 additional wells installed and sampled (1999) of which there were 2 shallow wells (039020 and 039021): VOCs
MNA (EnSafe)	1998-1999	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** ***Groundwater:*** 19 shallow wells (039001 - 039014, 039016, 039018 - 039021): VOCs, TOC, alkalinity, iron, sulfate, nitrate, and sulfide
CMS (EnSafe)	1998-1999	***Round 1*** **Soil:**	***Round 1*** **Groundwater:**

Table 4.3.3
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		15 surface borings (0 to 1 foot) (039SB047 – 039SB061): VOCs, SVOCs, and metals (1 duplicate collected for same parameters)	19 shallow wells (039001 - 039019): chloride, metals, and TDS (2 duplicates collected for same parameters)
CMS (EnSafe)	1998-1999	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 multi-level well installed and sampled (1999) (039024 M): VOCs
CH2M-Jones	2001	***Round 1*** **Soil** One surface boring (0 to 1 foot) (GDLSB02201): SVOCs, metals	***Round 1*** ***Groundwater*** No Groundwater Sample Collected.
CH2M-Jones	2002	***Round 1*** **Soil** No Soil Samples Collected	***Round 1*** ***Groundwater*** 1 shallow well (039023): VOCs, CH4, CO2.

Notes:
MNA = Monitored Natural Attenuation

Nature and Extent of Contaminants

Approximately 81 sample locations associated with SWMU 39 were evaluated for the presence of contaminants between 1995 and 2002. Of these 81, only one shallow monitoring well is within the boundaries of Drainage Basin 2. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. During the RFI BEQs, beryllium and Arochlor 1260 in soil and VOCs and inorganics in groundwater were identified as COPCs.

4.3.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at manhole 2-A on February 7, 2002 to determine if constituents are migrating from SWMUs/AOCs associated with Drainage Basin 2 into the Cooper River. Analytical detections for sample EFF005 are presented in Table 4.3.4.

Table 4.3.4
Storm Water Effluent Sampling Results
Drainage Basin 2

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
2	2-A	EFF005	Aluminum	520	3,277	NL	No
			Antimony	**6.00**	**5.93**	**NL**	**Yes**
			Barium	7.60	60.31	NL	No
			Cadmium	0.52	1.29	9.30	No
			Calcium*	20,000	53,455	NL	No
			Chromium	2.40	13.00	50	No
			Copper	12	41.98	2.90	No
			Iron	870	4,134	NL	No
			Lead	15	33.63	8.50	No
			Magnesium*	6,300	49,255	NL	No
			Manganese	20	74.52	NL	No
			Nickel	1.80	5.14	8.30	No
			Potassium*	2,500	23,678	NL	No
			Sodium*	51,000	395,333	NL	No
			Vanadium	8.50	15.59	NL	No
			Zinc	73	307.83	86	No
			bis(2-Ethylhexyl) phthalate	**4.00**	**NL**	**NL**	**Yes**
			Pentachlorophenol	**14**	**NL**	**7.90**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.3.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the storm water contaminant migration pathway scenarios described in Section 2.1.2 of the *Zone J RFI Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 2. Table 4.3.5 summarizes the migration pathway scenarios.

Table 4.3.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 2

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	No
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.3.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. No releases impacting the storm water sewer system within the boundaries of Drainage Basin 2 were discovered during review of environmental incident reports that were maintained by the former CNSY Environmental Office Code 106 between the time period from 1982 until base closure in 1996, and Environmental Baseline Survey (EBS) reports prepared for property transfer. Therefore, this pathway is considered incomplete.

4.3.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 10 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone A background concentrations and the ecological risk based screening criteria did identify two sample locations which have the potential to provide an upland source of antimony in the storm sewer system. Soil boring location 002SB009 had a detection of 18 mg/kg which exceeded the background surface soil screening value of 12 mg/kg for antimony, as did soil boring location 002SB015 with a detection of 13.3 mg/kg; however, these locations are bounded

by locations with non-detects for antimony prior to entry into the storm sewer system. There were no potential upland sources identified for bis(2-Ethylhexyl)phthalate and pentachlorophenol in the storm sewer system.

4.3.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 2 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with antimony intercepting the storm water drainage pipeline within Drainage Basin 2; however, a detection 2 µg/L for bis(2-Ethylhexyl)phthalate was detected at 039006 which is an upgradient monitoring well. There are no groundwater screening values for this compound. The compound was not detected in any down gradient monitoring wells; therefore, an upland source linkage does not exist for bis(2-Ethylhexyl)phthalate. A detection of 2 µg/L for pentachlorophenol was detected at 039011 which is located in the northwest corner pf Zone A. The compound was not detected in any down gradient monitoring well, therefore an upland source linkage does not exist.

4.3.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* (EnSafe, December 1998) indicates that there are no cross-connects present in Drainage Basin 2.

4.3.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 2 due to a lack of an upland terrestrial source identification.

4.4 Drainage Basin 3

Drainage Basin 3 encompasses approximately 16.43 acres within Zone A in the north section of the CNC along the Cooper River. Land cover within the drainage basin consists of approximately 50% unpaved surfaces (i.e., mostly grass), 30% paved surfaces and 20% buildings. Most storm water runoff within the drainage basin is directed to a storm sewer pipeline with 15 catch basins that discharges to the Cooper River via Outfall 3.

Figure 4-4 illustrates the area encompassing Drainage Basin 3 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.4.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there are two SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 3. The sites, SWMU 2 (Lead Contamination Area) and SWMU 39 (POL Drum Storage), are listed in Table 4.4.1, along with its current status. The boundary of SWMU 2 (Lead Contamination Area) transcends the boundary of Drainage Basin 2 along the west side where it extends into Drainage Basin 1-A, to the north into Drainage Basin 1, and also to the south where it crosses into Drainage Basin 3. The majority of SWMU 39 resides in Drainage Basins 1 and 1-A; however, one sample location is within the boundaries of Drainage Basin 3.

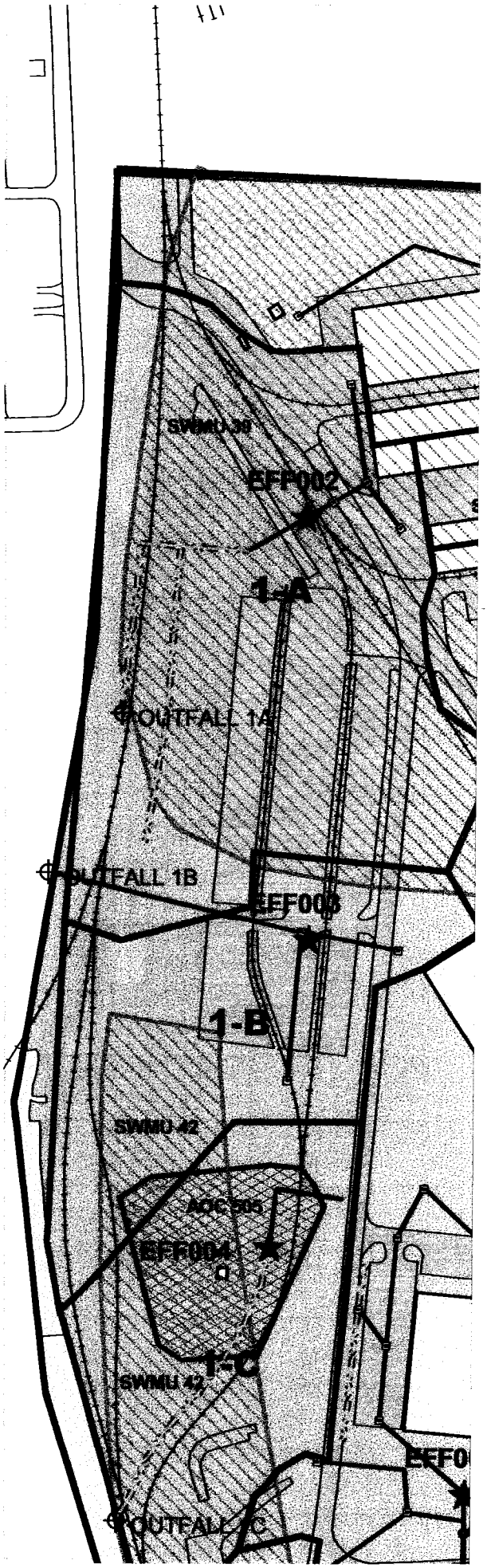
Table 4.4.1
Drainage Basin 3 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 2	Lead Contaminated Area	RFI complete; IM complete; CMS complete; NFA
SWMU 39	POL Drum Storage	RFI Complete, CMS ongoing

4.4.1.1 SWMU 2

Site Description and History

SWMU 2 consists of salvage bin No. 3 and the adjacent paved ground surface at the DRMO facility. The area was used to store recovered lead from lead-acid submarine batteries from the mid-1960s until 1984. Electrodes and associated internal metallic components were removed



N

200 0 200 Feet

LEGEND

Storm Water Effluent Sample

Drainage Basin

Storm Water Outfall

Storm Water Lines

Storm Water Catchbasin

Storm Water Drain Line

Storm Water Ditch

Groundcover

Gravel

Pavement

Soil/Grass

Wetland

SWMU/AOC

AOC Area

SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-4
Drainage Basin 3

January 2003	Zone J Main Project.apr

from the battery jars in the battery electrode treatment area at SWMU 5 in Zone E. Recovered materials were then placed on a railcar and transferred to the DRMO area for storage and eventual sale to a salvage contractor. The site had been designated for an RFI because of the historical lead concentrations in surrounding media and extensive sampling has been conducted at SWMU 2 from 1986 to 2002. Due to possible contaminant migration via surface water runoff from Hurricane Hugo in 1989, the investigation area for SWMU 2 had been expanded to cover a larger area, which also included SWMU 1.

Soil was sampled in 1986 from the DRMO site and in 1993 samples were collected to investigate soil and groundwater near SWMU2 to determine if Hurricane Hugo impacted the lead distribution onsite in 1989. Additionally, 11 sediment samples were collected from the Cooper River and storm sewer system in the vicinity. The RFI, conducted between October 1995 and January 1997, revealed elevated lead levels in the soil above clean levels established by CNC. Based on RFI analytical results and the risk assessment, several COCs requiring further evaluation through the CMS process were identified for surface soil and shallow groundwater. An IM was performed in 1999 to remove lead-contaminated soils and concrete after the RFI was complete.

Previous Investigations

A summary of investigative activities performed at SWMU 2 is presented in Table 4.4.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results for RFI activities prior to 2000 are presented in the *Final Zone A RFI Report.*

Table 4.4.2
Summary of SWMU 2 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Final Contamination and Exposure Assessment for	October 1986	Soil samples were collected for screening purposes.	
		Round 1	***Round 1***

Table 4.4.2
Summary of SWMU 2 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
lead Contamination within the DRMO (Environmental Science and Engineering)		**Soil:** 45 surface borings (0 to 0.5 feet) 10 subsurface borings (26 samples collected at various intervals) (SS-1 – SS-35, B1 – B10): Lead	**Groundwater:** No Groundwater Samples Collected.
1993 sampling event EnSafe/Allen & Hoshall	1993	After Hurricane Hugo impacted the lead distribution onsite in 1989, soil, groundwater, and sediment samples were collected in 1993 to determine the impact around SWMU 2.	
		Round 1 **Soil:** 22 surface borings (0 to 1 foot) 20 subsurface borings (3 to 5 feet) (S02SB001 – S02SB023): metals and cyanide (3 duplicates collected for same parameters) **Sediment:** 11 sediments collected; 4 of those were collected from catch basins (S02M0001 – S02M0004): metals and cyanide	***Round 1*** **Groundwater:** 6 shallow wells (CNSY0201 – CNSY0206): metals and cyanide (2 duplicates collected for same parameters)
Final Zones A and B RFI (EnSafe)	1995-1997	Site soil and groundwater investigation	
		Round 1 **Soil:** 24 surface borings (0 to 1 foot) 20 subsurface borings (3 to 5 feet) (002SB001 – 002SB015; 002SB019; 002SB023 – 002SB030): metals (6 duplicates collected for herbicides, hexavalent chromium, OP pesticides, and metals)	***Round 1*** **Groundwater:** 6 shallow wells (002001 – 002006): metals
Final Zones A and B RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** 16 surface borings (0 to 1 foot) 14 subsurface borings (3 to 5 feet) (002SB016 – 002SB018; 002SB020 – 002SB022; 002SB031 – 002SB041): metals (3 duplicates collected for same parameters and/or herbicides, hexavalent chromium, OP pesticides, and metals)	***Round 2*** **Groundwater:** 6 shallow wells (002001 – 002006): metals
Final Zones A and B RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 6 shallow wells

Table 4.4.2
Summary of SWMU 2 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			(002001 – 002006): metals
Final Zones A and B RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 5 shallow wells (002001 – 002004; 002006): metals, TDS, chloride, and sulfate
CMS (EnSafe)	1998-1999	Soil and shallow groundwater investigation	
		Round 1 **Soil:** 34 surface borings (0 to 1 foot) (002SBC01 – 002SBC04): Total Lead (002SBC011A – 002SBC41A): SPLP metals (002SBC011B – 002SBC041B): TCLP metals	***Round 1*** **Groundwater:** Five shallow wells (002002, 002003, 002007, and 002008): chloride, metals, and TDS (002004): chloride, metals, pesticides, and TDS
IM	1999	Soil investigation Report states that 19 samples were actually samples for TCLP Total Lead	
CH2M-Jones	2002	Groundwater investigation	
		Round 1 **Soil:** No Soil Sample Collected.	***Round 1*** **Groundwater:** 1 shallow well (002004): VOC

Nature and Extent of Contaminants

Approximately 175 sample locations associated with SWMU 2 were evaluated for the presence of contaminants between 1986 and 2002. Of these 175, approximately 62 locations are within the boundaries of Drainage Basin 3. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. During the RFI, arsenic, beryllium, and lead in soil and lead in groundwater were identified as chemicals of potential concern (COPCs). Detections of lead in groundwater occurred in only one (002005) of six wells and were determined to be attributed to high lead concentrations in the surrounding soil. Given that lead was not detected in any of the other monitoring wells onsite, indicating contamination migration was not occurring, groundwater was not considered an immediate concern at the site. Based on the analytical

results and the human health risk assessment for the combined site, a CMS was recommended for both soil and shallow groundwater at SWMU 2. Based on the analytes detected and the overall surface flow in the area, it was also recommended that the CMS investigation include SWMU 1.

4.4.1.2 SWMU 39

Site Description and History

SWMU 39 refers to a former POL drum storage area situated north of Building 1604, near the northern boundary of CNC. Currently, the portion of the site adjacent to Building 1604 is paved, while the portion that continues north to the property boundary is gravel–covered. Due to the close proximity of the Hess Oil Inc. tank farm to the property boundary, the potential for petroleum releases from offsite sources to impact CNC property was included in the scope of the site investigation.

Previous Investigations

A summary of investigative activities performed at SWMU 39 is presented in Table 4.4.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results for RFI activities prior to 2000 are presented in the *Final Zone A RFI Report*.

Table 4.4.3
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation	
		Round 1 **Soil:** 15 surface borings (0 to 1 foot) 15 subsurface borings (3 to 5 feet) (039SB001 – 039SB015): VOCs, SVOCs, metals, pesticides/PCBs, and TPH (2 duplicates collected for same parameters plus herbicides, cyanide, hexavalent chromium, OP pesticides,	***Round 1*** **Groundwater:** 5 shallow wells (039001 - 039005): VOCs, SVOCs, metals, pesticides/PCBs, TPH (1duplicate collected for same parameters plus herbicides, cyanide, OP pesticides, chloride, sulfate, dioxins, hexavalent

Table 4.4.3
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		and dioxins)	chromium, and TDS)
RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** 25 surface borings (0 to 1 foot) 25 subsurface borings (3 to 5 feet) (039SB016 – 039SB018, 039SB020, and 039SB025): TPH and pesticides/PCBs (039SB022 – 039SB024, and 039SB038): TPH and SVOCs (039SB019, 039SB021, 039SB026 – 039SB037, and 039SB039 – 039SB040): TPH (1 duplicate collected for same parameters plus herbicides, cyanide, hexavalent chromium, OP pesticides, and dioxins)	***Round 2*** **Groundwater:** 5 shallow wells (039001 - 039005): VOCs
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (039SB041 – 039SB043): VOCs	***Round 3*** **Groundwater:** 5 shallow wells (039001 - 039005): VOCs, SVOCs, metals, and hexavalent chromium (1 duplicate collected for same parameters plus cyanide and dioxins)
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 5 shallow wells (039001 - 039003,): VOCs, SVOCs, metals, chloride, sulfate, hexavalent chromium, and TDS (039004 and 039005): VOCs, SVOCs, metals, chloride, sulfate, hexavalent chromium, dioxins, and TDS (1duplicate collected for same parameters)
RFI (EnSafe)	1995-1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 10 additional wells installed and sampled (1996)-of which there were 7 shallow wells: 7 shallow wells (039006 - 039012): VOCs
RFI (EnSafe)	1995-1997	***Round 6*** **Soil:**	***Round 6*** **Groundwater:**

Table 4.4.3
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		1 biased sample (039SB10I02): VOCS and SVOCs	7 additional wells installed and sampled (1996)-of which there were no shallow wells installed.
RFI (EnSafe)	1995-1997	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 12 shallow wells (039001, 039002): VOCs, SVOCs, metals, chloride, sulfate, hexavalent chromium, dioxins, and TDS (039003): VOCs, SVOCs, metals, chloride, sulfate and TDS (039004): VOCs, SVOCs, metals, chloride, sulfate, dioxins, and TDS (039005): VOCs, SVOCs, metals, chloride, sulfate, pesticides/PCBs, cyanide, dioxins, and TPH (039006 - 039012): VOCs, SVOCs, metals, chloride, sulfate, dioxins, and TDS (2 duplicates collected for VOCs, SVOCs, chloride, sulfate, metals, dioxins, and TDS)
RFI (EnSafe)	1995-1997	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** 5 additional wells installed and sampled (1997)- of which there were 3 shallow wells. 3 shallow wells (039013 - 039015): VOCs, SVOCs, metals, pesticides/PCBs, and cyanide
RFI (EnSafe)	1995-1997	***Round 10*** **Soil:** No Soil Samples Collected.	***Round 10*** **Groundwater:** 7 shallow wells (039008 - 039010, 039012, and 039013): VOCs, SVOCs, metals, chloride, sulfate, dioxins, TDS, and TPH (039014 and 039015): VOCs, SVOCs, alkalinity, ammonia, chloride, cyanide, ferrous iron, nitrate, phosphorous, sulfate, sulfide, BOD, metals, and pesticides/PCBs (1 duplicate collected for VOCs, SVOCs, chloride, sulfate, dioxins, metals, TDS, and TPH)

Table 4.4.3
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	***Round 11*** **Soil:** No Soil Samples Collected.	***Round 11*** **Groundwater:** 10 shallow wells (039006 - 039015): VOCs and SVOCs (2 duplicates collected for same parameters)
RFI (EnSafe)	1995-1997	***Round 12*** **Soil:** No Soil Samples Collected.	***Round 12*** **Groundwater:** 10 shallow wells (039006 - 039015): VOCs, SVOCs, and metals (1 duplicate for same parameters)
MNA (EnSafe)	1998-1999	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 15 shallow wells (039001 - 039015): VOCs, TOC, and sulfate
MNA (EnSafe)	1998-1999	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 14 shallow wells (039001 - 039014): VOCs, TKN, TOC, nitrate, phosphorous, sulfate, and sulfide 12 additional wells installed and sampled (1998)- of which there were 4 shallow wells 4 shallow wells (039016 - 039019): VOCs, TKN, TOC, nitrate, phosphorous, sulfate, and sulfide
MNA (EnSafe)	1998-1999	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** **Confirmatory Sampling** 5 shallow wells (039009, 039016 - 039019): VOCs 6 additional wells installed and sampled (1999)- of which there were 2 shallow wells 2 shallow wells (039020 and 039021): VOCs
MNA (EnSafe)	1998-1999	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 19 shallow wells (039001 - 039014, 039016, 039018

Table 4.4.3
Summary of SWMU 39 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			- 039021): VOCs, TOC, alkalinity, iron, sulfate, nitrate, and sulfide
CMS (EnSafe)	1998-1999	***Round 1*** **Soil:** 15 surface borings (0 to 1 foot) (039SB047 – 039SB061): VOCs, SVOCs, and metals (1 duplicate collected for same parameters)	***Round 1*** **Groundwater:** 19 shallow wells (039001 - 039019): chloride, metals, and TDS (2 duplicates collected for same parameters)
CMS (EnSafe)	1998-1999	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 multi-level well installed and sampled (1999) (039024 M): VOCs
CH2M-Jones	2001-2002	Groundwater investigation	
	2001	***Round 1*** **Soil:** No Soil Samples Collected	***Round 1*** **Groundwater:** 2 shallow wells (039012 – 039013): VOCs, metals, general chemistry, CH4/CO2
CH2M-Jones	2001	***Round 2*** **Soil:** No Soil Samples Collected	***Round 2*** **Groundwater:** 2 shallow wells (039012 – 039013): metals, general chemistry, CH4/CO2
CH2M-Jones	2001	***Round 3*** **Soil:** No Soil Samples Collected	***Round 3*** **Groundwater:** 2 shallow wells (039012 – 039013): VOCs, metals, general chemistry, methane, and carbon dioxide
CH2M-Jones	2001	***Round 4*** **Soil:** No Soil Samples Collected	***Round 4*** **Groundwater:** 2 shallow wells (039012 – 039013): VOCs, metals, general chemistry, CH4/CO2
CH2M-Jones	2002	***Round 5*** **Soil:** No Soil Samples Collected	***Round 5*** **Groundwater:** 2 shallow wells (039012 – 039013): VOCs, metals, general chemistry, methane, and carbon dioxide
CH2M-Jones	2002	***Round 6*** **Soil:** No Soil Samples Collected	***Round 6*** **Groundwater:** (039006 – 039007): VOCs

Nature and Extent of Contaminants

Approximately 81 sample locations associated with SWMU 39 were evaluated for the presence of contaminants between 1995 and 2002. Of these 81, approximately 7 sample locations are within the boundaries of Drainage Basin 3. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. During the RFI BEQs, beryllium and Arochlor 1260 in soil; and VOCs and inorganics in groundwater were identified as COPCs.

4.4.2 Storm Water Effluent Evaluation

Two storm water effluent samples were collected at catch basin 3-A and catch basin 3-B on January 15 and February 7, 2002, respectively to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 3 into the Cooper River. Analytical detections for samples EFF006 and CAP001 are presented in Table 4.4.4. CAP001 was a capped location that collected storm water runoff from the surrounding area.

Table 4.4.4
Storm Water Effluent Sampling Results
Drainage Basin 3

					Screening Value (µg/L)		
Drainage Basin	**Catch Basin/ Manhole ID**	**Sample ID**	**Parameter**	**Concentration (µg/L)**	**Reference Concentration**	**Chronic Saltwater Screening Value**	**Potential COPC**
3	3-B	EFF006	Aluminum	1,200	3,277	NL	No
			Barium	17	60.31	NL	No
			Cadmium	0.60	1.29	9.30	No
			Calcium*	66,000	53,455	NL	No
			Chromium	4.70	13	50	No
			Cobalt	1.40	2.00	NL	No
			Copper	34	41.98	2.90	No
			Iron	2,100	4,134	NL	No
			Lead	**80**	**33.63**	**8.50**	**Yes**
			Magnesium*	10,000	49,255	NL	No
			Manganese	41	74.52	NL	No
			Nickel	4.50	5.14	8.30	No
			Potassium*	5,100	23,678	NL	No
			Sodium*	81,000	395,333	NL	No
			Vanadium	8.80	15.59	NL	No
			Zinc	51	307.83	86	No
			Pentachloro-phenol	**14**	**NL**	**7.90**	**Yes**
	3-A	CAP001	Aluminum	250	3,277	NL	No

Table 4.4.4
Storm Water Effluent Sampling Results
Drainage Basin 3

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Arsenic	35	6.88	36	No
			Barium	5.60	60.31	NL	No
			Calcium*	19,000	53,455	NL	No
			Chromium	11	13	50	No
			Iron	190	4,134	NL	No
			Lead	4.30	33.63	8.50	No
			Magnesium*	560	49,255	NL	No
			Manganese	4.20	74.52	NL	No
			Nickel	3.10	5.14	8.30	No
			Potassium*	10,000	23,678	NL	No
			Sodium*	21,000	395,333	NL	No
			Thallium	5.20	5.77	21.30	No
			Vanadium	**21**	**15.59**	**NL**	**Yes**
			Zinc	28	307.83	86	No
			Mercury	**0.22**	**NL**	**0.025**	**Yes**
			bis(2-Ethylhexyl) phthalate	**1.40**	**NL**	**NL**	**Yes**
			Cyanide	5.40	16.33	1.00	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.4.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the storm water contaminant migration pathway scenarios described in Section 2.1.2 of the *Zone J RFI Storm Water Effluent Evaluation Report* to determine the applicability of each scenario to Drainage Basin 3. Table 4.4.5 summarizes the migration pathway scenarios.

Table 4.4.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 3

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	No
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	Yes
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	Yes

Table 4.4.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 3

Scenario	Pathway Description	Is Pathway Complete?
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.4.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. No releases impacting the storm water sewer system within the boundaries of Drainage Basin 3 were discovered during review of environmental incident reports that were maintained by the former CNSY Environmental Office Code 106 between the time period from 1982 until base closure in 1996, and EBS reports prepared for property transfer. Therefore, this pathway is considered incomplete.

4.4.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that within the drainage basin, seven of 15 catch basins are located near sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone A background concentrations and the ecological risk-based screening criteria identified multiple locations exist (Figure 4-4A), which have the potential to provide an upland source consistent with the COPCs identified in Table 4.4.4. A summary of this evaluation is provided in Table 4.4.6.

100 0 100 eet

N

LEGEND

- Soil Linkage Sample
- Surface Soil Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-4A
Drainage Basin 3
Soil Sample Linkage Locations

November 2002 | Zone J Main Project.apr

Table 4.4.6
Drainage Basin 3
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, Charleston, South Carolina

Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Level (mg/kg)	Distance (ft) to Catch Basin
3-B	002SB020	Mercury	1.90	0.20 (BKG)	105.7
		Lead	3,870	72 (BKG)	105.7
3-C	002SB021	Mercury	2.60	0.20 (BKG)	108.5
		Lead	584	72 (BKG)	108.5
	002SB022	Mercury	1.30	0.20 (BKG)	94.8
		Lead	162	72 (BKG)	94.8
	S02SB011	Mercury	15	0.20 (BKG)	49.5
		Lead	1,600	72 (BKG)	49.5
	S02SB021	Mercury	0.41	0.20 (BKG)	121.8
		Lead	480	72 (BKG)	121.8
3-D	002SB023	Mercury	0.60	0.20 (BKG)	59.0
		Lead	427	72 (BKG)	59.0
	002SB039	Lead	326	72 (BKG)	102.7
	S02SB012	Lead	160	72 (BKG)	40.2
	S02SB021	Lead	480	72 (BKG)	99.8
	S02SB021	Lead	480	72 (BKG)	99.8
		Mercury	0.41	0.20 (BKG)	99.8
3-E	002SB028	Lead	1,500	72 (BKG)	73.8
		Vanadium	114	32 (BKG)	73.8
3-F	*002SB029	Lead	1,050	72 (BKG)	124.9
		Vanadium	50.8	32 (BKG)	124.9
3-M	*002SB034	Lead	190	72 (BKG)	36.1

Notes:
BKG = Background Concentration
* = Samples are located under pavement. Associated contaminants are not likely be transported to storm water via this scenario.

Evaluation of surface soil data to determine possible upland terrestrial source identification with EFF006 and CAP001 COPCs revealed that lead, mercury, and vanadium were detected in surface soil above screening criteria at locations within 30 to 125 feet of several catch basins These locations are not bounded by non-detects. Therefore, the pathway is complete for the above three COPCs. There were no potential upland sources identified for bis(2-Ethylhexyl)phthalate and pentachlorophenol. Additional characterization will be required to reduce the uncertainty of these locations as potential sources due to the distances involved with

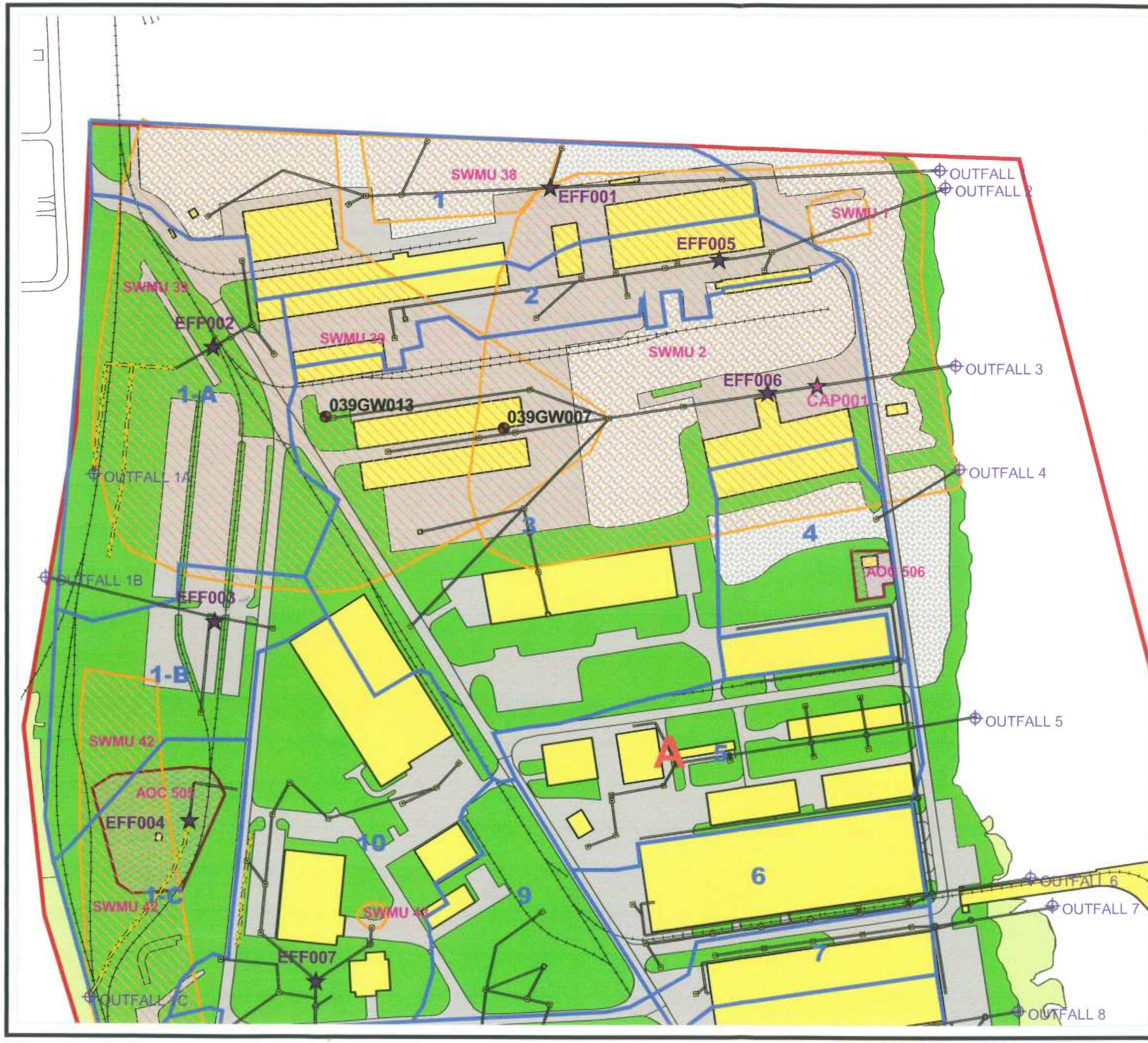
the surface soil locations presented in the above table. The COPCs identified will be further evaluated during the COPC Refinement process for the Cooper River SLERA.

4.4.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 3 were reviewed. There is a groundwater divide across Drainage Basin 3 extending from the southwest to northeast corners of the drainage basin. This divide causes groundwater on the western side of Drainage Basin 3 to flow to the northwest. Therefore the northern arm of the storm water drain line leading to Outfall 3 passes through the groundwater flow path between wells 039007 and 039013. Mercury was the only potential COPC that had concentrations exceeding the shallow groundwater background screening criteria. Table 4.4.7 summarizes the mercury detections in groundwater in wells 039007 and 039011. Figure 4-4B illustrates the groundwater locations.

Table 4.4.7
Drainage Basin 3
Scenario 1c Evaluation
Charleston Naval Complex, Charleston, South Carolina

Drainage Basin	Well ID	COPCs Consistent with EFF006	Concentration (µg/L)	Screening Value (µg/L)	Distance to Storm Water Line
3	039007	Mercury	0.30	0.025 (BKG)	12 ft. upgradient
	039013	Mercury	0.17	0.025 (BKG)	21 ft down gradient



200 0 200 Feet

N

LEGEND

- Groundwater Linkage Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-4B
Drainage Basin 3
Groundwater Sample Linkage Locations

November 2002 | Zone J Main Project.apr

4.4.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 3.

4.4.4 Summary of Potential COPCs

Table 4.4.8 summarizes the potential COPCs that have been included for further characterization during the COPC Refinement process for the Cooper River.

Table 4.4.8
Summary of Potential COPCs
Drainage Basin 3

Potential COPC	Pathway of Concern
Lead	Scenario 1b
Mercury	Scenario 1b Scenario 1c
Vanadium	Scenario 1b

4.5 Drainage Basin 18

Drainage Basin 18 encompasses approximately 8.44 acres within Zone B in the north section of the CNC on the Cooper River. Land cover within the drainage basin consists of approximately 88% unpaved surfaces (i.e., mostly grass), 10% paved surfaces and 2% buildings. Most storm water runoff within the drainage basin is directed to one of eleven catch basins connected to storm sewer pipelines that discharge to the Cooper River via Outfall 18. Some sheet flow from the western portion of the drainage basin flows directly into the Cooper River.

Figure 4-5 illustrates the area encompassing Drainage Basin 18 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.5.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there is one AOC that is primarily within the boundary of Drainage Basin 18. The site is listed in Table 4.5.1, along with its current status. An investigation of AOC 507 was conducted that determined no further remedial action was warranted. Though AOC 507 current status is NFA, a storm water effluent sample was collected for comparison to reference location values presented in the *Zone J RFI Storm Water Effluent Evaluation Report*.

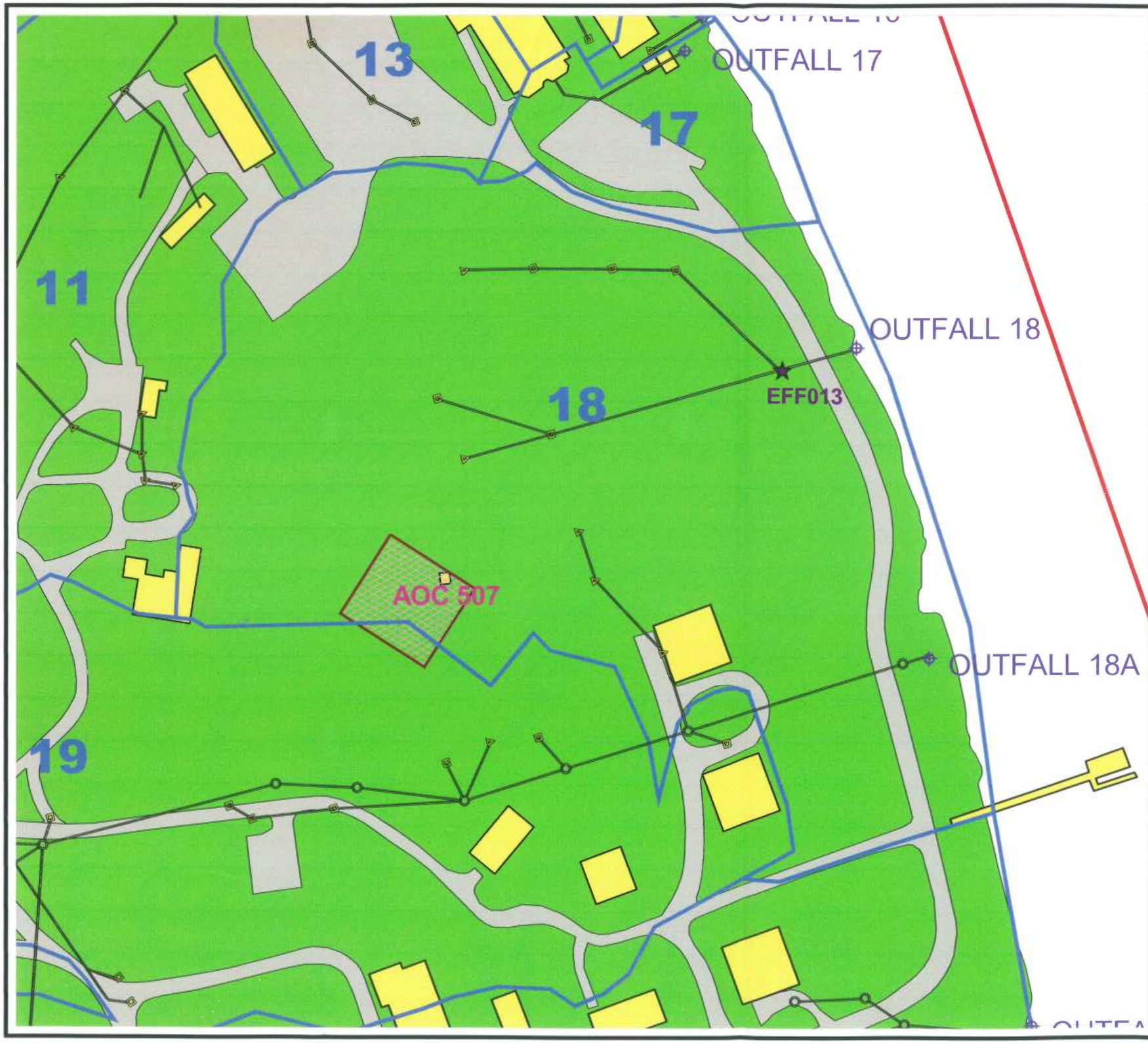
Table 4.5.1
Drainage Basin 18 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 507	Oil Storehouse	NFA

4.5.1.1 AOC 507

Site Description and History

AOC 507 is former Building 1010; an oil storehouse built on the former CNC golf course and was demolished more than 80 years ago. Due to the period of operation, it is unlikely that containment and spill cleanup procedures were in place. A review of historical maps and drawings indicated that the structure was at the end of a cul-de-sac. Another small structure of unknown construction date is currently in the vicinity. Because this information was discovered



N

100 0 100 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-5
Drainage Basin 18

November 2002 | Zone J Main Project.apr

after the June 1995 RFA Report, the AOC 507 investigation area was relocated to the actual location of Building 1010. The relocation of the AOC investigation area was also included in the *Final Zone B RFI Report* (EnSafe/Allen&Hoshall, November 1996).

Materials of concern, identified in the *Final Zone B RFI Report*, at AOC 507 included POLs. Because AOC 507 is in the former residential and golf course portion of Zone B, current and future land users were identified as potential receptors that might be exposed to site contaminants. There was also a concern that since the Cooper River is approximately 300 feet from the site there was a potential for exposure to biological receptors.

To fulfill CSI objectives, soil was sampled in accordance with the *Final Zones A and B RFI Work Plan*, (EnSafe/Allen & Hoshall, September 1995) to confirm whether any contamination resulted from onsite activities at AOC 507.

Previous Investigations

A summary of investigative activities performed at AOC 507 is presented in Table 4.5.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone B RFI Report*.

Table 4.5.2
Summary of AOC 507 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1996	Site soil investigation	
		Round 1 **Soil:** 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (507SB001 – 507SB005): VOCs, SVOCs, metals (1 duplicate collected for same parameters plus herbicides, cyanide, hexavalent chromium, OP pesticides, and dioxins)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Table 4.5.2
Summary of AOC 507 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1996	***Round 2*** **Soil:** 5 surface borings (0 to 1 foot) (507SB006-507SB010): SVOCs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1995-1996	***Round 3*** **Soil:** 3 surface borings (0 to 1 foot) (507SB011-507SB013): SVOCs	***Round 3*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 13 sample locations associated with AOC 507 were evaluated for the presence of contaminants in October 1995, March 1996, and June 1996. All sample locations are within the boundaries of Drainage Basin 18. Surface and subsurface samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site attributable to possible spills occurring in the area.

The Zone B RFI was conducted to determine if AOC 507 posed unacceptable risk to human health or the environment (ecological concerns) and if it will require additional evaluation under the CMS. Based upon the degree of contamination, the limited habitat within Zone B, and the limited migration pathways to ecological habitats of concern, human and ecological risks related to Zone B were considered to be minimal.

4.5.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at catch basin 18-A on March 2, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 18 into the Cooper River. Analytical detections for sample EFF013 are presented in Table 4.5.3.

Table 4.5.3
Storm Water Effluent Sampling Results
Drainage Basin 18

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
18	18-A	EFF013	Aluminum	1,200	3,277	NL	No
			Arsenic	3.90	6.88	36	No
			Barium	9.90	60.31	NL	No
			Calcium*	66,000	53,455	NL	No
			Chromium	2.20	13	50	No
			Copper	8.70	41.98	2.90	No
			Iron	1,500	4,134	NL	No
			Lead	4.70	33.63	8.50	No
			Magnesium*	93,000	49,255	NL	No
			Manganese	39	74.52	NL	No
			Nickel	2.10	5.14	8.30	No
			Potassium*	41,000	23,678	NL	No
			Sodium*	800,000	395,333	NL	No
			Vanadium	5.30	15.59	NL	No
			Zinc	44	307.83	NL	No
			Mercury	**0.12**	**NL**	**0.025**	**Yes**
			2-Methylphenol (o-Cresol)	**4.30**	**NL**	**NL**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.5.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Zone J RFI Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 18. Table 4.5.4 summarizes the migration pathway scenarios.

Table 4.5.4
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 18

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	No
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.5.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. No releases impacting the storm water sewer system within the boundaries of Drainage Basin 18 were discovered during review of environmental incident reports that were maintained by the former CNSY Environmental Office Code 106 between the time period from 1982 until base closure in 1996, and EBS reports prepared for property transfer. Therefore, this pathway is considered incomplete.

4.5.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 11 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone B background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source of mercury or 2-methylphenol (o-Cresol) in the storm sewer system.

4.5.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. There was no groundwater data collected within Drainage Basin 18 associated with AOC 507.

4.5.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 18.

4.5.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 18 due to a lack of an upland terrestrial source identification.

4.6 Drainage Basin 20

Drainage Basin 20 encompasses approximately 76 acres within Zones B, C, and E in the north section of the CNC. Land cover within the drainage basin consists of approximately 55% unpaved surfaces, 20% paved surfaces, and 25% buildings. Storm water runoff within the drainage basin is directed to approximately 185 catch basins that discharge to the Cooper River via Outfall 20.

Figure 4-6 illustrates the area encompassing Drainage Basin 20 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.6.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there are twelve SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 20. Each site is listed in Table 4.6.1, along with its current status. Five sites (SWMU 53, AOC 513, AOC 515, AOC 519 and AOC 525) had been designated as no further action sites prior to Zone J data collection and were not included in the Zone J data evaluation. The remaining seven sites include SWMU 47 (Burning Dump), AOC 508 (Former Incinerator), AOC 511 (Oil House), AOC 516 (Building 233 Wash Area), AOC 517 (Indoor Firing Range), AOC 518 (Coal Storage Bins), and AOC 526 (Building 212 Paint Area). Note that due to their proximity to each other, AOC 516 and SWMU 47 are assessed together; and AOC 508 and AOC 511 are assessed together.

Table 4.6.1
Drainage Basin 20 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 47	Burning Dump	RFI Complete; CMS Work Plan; NFA
SWMU 53	Building 212 SAA	Draft RFI Report
AOC 508	Former Incinerator	Draft RFI Report; CMS Report; NFA
AOC 511	Oil House	Draft RFI Report; CMS Report; NFA
AOC 513	Former Morgue	RFI Complete, NFA
AOC 515	Former Incinerator & Paint Shop	Draft RFI Report
AOC 516	Building 233 Wash Area	RFI Complete; IM Completion Report; NFA
AOC 517	Indoor Firing Range	Draft RFI Report; CMS Work Plan
AOC 518	Coal Storage Bins	RFI Complete; CMS Work Completion Report; NFA
AOC 519	Former Boilerhouse	RFI Complete, NFA

SUMMARY OF DRAINAGE BASIN DB-20
POTENTIAL COPCs

Potential COPC	Pathway of Concern
Aluminum	Scenario 1c
Iron	Scenario 1b, 1c
Lead	Scenario 1b
Zinc	Scenario 1b
Bis(2-Ethylhexyl)phthalate	Scenario 1b

N

400 0 400 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-6
Drainage Basin 20

January 2003	Zone J Main Project.apr

Table 4.6.1
Drainage Basin 20 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 525	Paint Shop, Building 223	Draft RFI Report ; RFI Report Addendum
AOC 526	Building 212 Paint Area	Draft RFI Report

4.6.1.1 SWMU 47/AOC 516
Site Description and History

SWMU 47 was a burning dump in the late 1920s where various types of wastes (including medical waste) were reportedly burned. Petroleum releases have also been reported onsite. SWMU 47 includes Buildings NSC-64, NSC-66, and NSC-67 and the surrounding asphalt and grassed areas as well as the property north of Turnbull Avenue where former Building NH-1137 was located (prior to demolition) and its associated parking lot and grassed areas. The RFI focused on site environmental medial potentially impacted by products of incomplete combustion and residual petroleum hydrocarbons.

AOC 516 is immediately west of SWMU 47 and includes Building 233. This area was used for spray washing vehicles and equipment from 1972 until the 1980s. Prior to the base closure in the spring of 1996, AOC 516 was used for recharging lead-acid batteries. Chemicals of potential concern included lead and other inorganics, solvents, acids, and petroleum hydrocarbons.

Previous Investigations

A summary of investigative activities performed at SWMU 47/AOC 516 is presented in Table 4.6.2, which contains the date of activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Zone C RFI Report (EnSafe, 1997)*.

Table 4.6.2
Summary of SWMU 47/AOC 516 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
RFI (EnSafe)	1995-1996	***Site soil and groundwater***

Table 4.6.2
Summary of SWMU 47/AOC 516 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		investigation	
		Round 1 **Soil:** 16 surface borings (0 to 1 foot) 13 subsurface borings (3 to 5 feet) (047SB001 – 013, and 015; 516SB001 – 002): VOCs, SVOCs, metals, pesticides/PCBs, TPH, cyanide (2 duplicates collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins)	***Round 1*** **Groundwater:** 14 shallow wells (047001 – 013 and 015): VOCs, SVOCs, metals, pesticides/PCBs, TPH, and cyanide (2 duplicates collected for same parameters plus herbicides, OP pesticides, dioxins and hexavalent chromium)
RFI (EnSafe)	1995-1996	***Round 2*** **Soil:** 8 surface borings (0 to 1 foot) (047SB016 – 023): SVOCs (2 duplicates collected for same parameter)	***Round 2*** **Groundwater:** 14 shallow wells (047001 – 013 and 015): VOCs, SVOCs, metals, pesticides/PCBs, TPH, and cyanide (1 duplicate collected for same parameters)
RFI (EnSafe)	1995-1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 14 shallow wells (047001 – 013 and 015): VOCs, SVOCs, metals, pesticides/PCBs, TPH, and cyanide (1 duplicate collected for same parameters)
RFI (EnSafe)	1995-1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 14 shallow wells (047001 – 013 and 015): VOCs, SVOCs, metals, pesticides/PCBs, TPH, and cyanide (1 duplicate collected for same parameters)
CMS (EnSafe)	1999	***Round 1*** **Soil:** 9 surface borings (0 to 1 foot) 9 subsurface borings (3 to 5 feet) (516SBC01 – 516SBC04): Lead and arsenic (516SBC05 – 516SBC09): Dioxins	***Round 1*** **Groundwater:** 2 shallow wells (047001 & 047011): Total Suspended Solids (TSS) and metals (filtered and unfiltered)
CMS (EnSafe)	1999	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (047011): metals (filtered and unfiltered)

Nature and Extent of Contaminants

Approximately 47 sample locations associated with SWMU 47/AOC 516 were evaluated for the presence of contaminants between 1995 and 1999. Of these 47, approximately 45 sample locations are within the boundaries of Drainage Basin 20. Of particular interest were detections of arsenic and BEQs in surface soil; and arsenic in groundwater. Subsequent evaluations as part of the CMS determined that neither BEQs nor arsenic were present in soil at levels to warrant remedial action; however, a localized area of lead contamination in soil was identified during the investigation. Soil excavation and removal to eliminate lead concentrations exceeding the residential risk threshold (400 mg/kg) was recommended for the area. It was also recommended that prior to remedial goal development pertaining to groundwater, subsequent sampling should be performed to confirm the presence of arsenic in this media.

4.6.1.2 AOC 508/AOC 511

Site Description and History

AOC 508 refers to the former site of an incinerator operated at the CNC from 1922 to 1929. Specifications and operating practices associated with the incinerator are unknown. Currently, the site is a grass-covered area approximately 75-feet x 75-feet in size, located along Avenue H, north of Building 762.

AOC 511 refers to the former site of an oil storehouse, which was in operation from 1922 to late 1954. Specifications and operating practices associated with the storehouse are unknown. Currently, this site is a small, grass-covered area located between AOC 508 and Building 762.

In May 1998, the DET removed an underground storage tank at this combined site. The 1,000-gallon tank had been used to store heating fuel oil over an approximately 20 year period. Upon completion of removal activities, the Navy Environmental Detachment (DET) issued a completion report indicating that the removal action had successfully mitigated benzene, toluene, ethyl-benzene, xylene (BTEX) and PAH concentration concerns and that no further remedial actions were warranted at the site.

Previous Investigations

A summary of investigative activities performed at AOC 508/AOC 511 is presented in Table 4.6.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone C RFI Report*.

Table 4.6.3
Summary of AOC 508/AOC 511 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	***Round 1*** **Soil:** 12 surface borings (0 to 1 foot) 6 subsurface borings (3 to 5 feet) (508SB001 – 508SB006, 511SB001 – 511SB006): VOCs, SVOCs, metals, cyanide, pesticides/PCBs, and TPH (2 duplicates collected for same parameters plus herbicides, dioxins, hexavalent chromium, and OP pesticides	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** 7 surface borings (0 to 1 foot) (508SB007 – 508SB009, 511SB007 – 511SB010): SVOCs, metals, and pesticides/PCBs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** Two shallow wells (508003): Pesticides/PCBs (511002): VOCs, SVOCs, and pesticides/PCBs
IM (DET)	1998	Removal of 1,000-gallon fuel oil tank and surrounding soil due to presence of BTEX and PAHs. According to the completion report, contamination was successfully removed.	***No data available for review.***
CMS (EnSafe)	1999	***Round 1*** **Soil:** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (508SBC01 – 508SBC04): Dieldrin (1 duplicate collected for same parameters)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 25 sample locations associated with AOC 508/AOC 511 were evaluated for the presence of contaminants between 1995 and 1999. Of these 25, approximately 18 sample locations are within the boundaries of Drainage Basin 20. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination. Of particular interest were detections of BEQs, chlordane, dieldrin, and DDT in surface soil. Subsequent evaluations as part of the CMS indicated that the interim measure removal action had been successful in mitigating risk associated with the site. Based on data generated during the CMS, no further action was recommended for AOC 508/AOC 511.

4.6.1.3 AOC 517

Site Description and History

AOC 517 is the former Indoor Firing Range, Building M-192, which operated from 1959 until 1974. Waste generated at this site consisted of spent lead slugs from the pistol range.

Previous Investigations

A summary of investigative activities performed at AOC 517 is presented in Table 4.6.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone C RFI Report*.

Table 4.6.4
Summary of AOC 517 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Soil and interior building surfaces investigation for the presence of contaminants, primarily lead.	
		Round 1 **Soil:** 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (517SB001- 517SB005): VOCs, SVOCs, metals, cyanide, and	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Table 4.6.4
Summary of AOC 517 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
		pesticides/PCBs (1 duplicate collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins)

Nature and Extent of Contaminants

Approximately 17 sample locations associated with AOC 517 were evaluated for the presence of contaminants in 1995. All sample locations are within the boundaries of Drainage Basin 20. Surface, subsurface and interior wipe samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. No COCs were identified during the RFI; therefore, a CMS was not recommended. Wipe samples collected confirmed the presence of lead on the interior walls of M-192, which may pose a health risk from an industrial hygiene standpoint depending on the intended future use of the building.

4.6.1.4 AOC 518

Site Description and History

AOC 518 refers to a former coal storage bin site, which was used from 1926 to 1937. Currently, the site is a gravel and asphalt parking area, partially covered by Building M-1257. An investigation was performed to identify potential impacts resulting from coal storage onsite.

Previous Investigations

A summary of investigative activities performed at AOC 518 is presented in Table 4.6.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone C RFI Report*.

Table 4.6.5
Summary of AOC 518 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1996	A soil investigation was performed to identify potential impacts to the site from coal storage.	
		Round 1 **Soil:** 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (518SB001 – 518SB005): VOCs, SVOCs, metals, cyanide, and pesticides/PCBs (1 duplicate collected for herbicides, hexavalent chromium, OP pesticides, and dioxins)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1995-1996	***Round 2*** **Soil:** 5 surface borings (0 to 1 foot) (518SB006): Pesticides/PCBs (518SB007): SVOCs and pesticides/PCBs (518SB008 – 518SB010): metals VOCs, SVOCs, metals, cyanide, and pesticides/PCBs (1 duplicate collected for herbicides, hexavalent chromium, OP pesticides, metals, VOCs, SVOCs, and dioxins)	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
CMS (EnSafe)	1999	***Round 1*** **Soil:** 14 surface borings (0 to 1 foot) 14 subsurface borings (3 to 5 feet) (518SBC01 – 518SBC03): Chlordane (518SBC04 – 518SBC07): Chlordane and Lead (518SBC08 – 518SBC14): Lead (1 duplicate collected for each set of parameters)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 24 sample locations associated with AOC 518 were evaluated for the presence of contaminants between 1995 and 1999. All sample locations are within the boundaries of Drainage Basin 20. Surface and subsurface soil samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site

attributable to coal storage. Of particular interest were detections of chlordane in surface soil. Based on lead and chlordane levels encountered during the CMS, excavation of the delineated area to the residential cleanup goal of 400 mg/kg for lead and the chlordane risk-based concentration (RBC) of 1,800 μg/kg was recommended for the site.

4.6.1.5 AOC 526

Site Description and History

AOC 526, a paint area, formerly operated in Building 212, was used for spray painting ship components. Two types of metal-based paints were used for this process. Operations commenced in 1974 and continued until approximately 1993. This unit has been cleaned and all waste sludge has been removed and properly disposed.

Previous Investigations

A summary of investigative activities performed at AOC 526 is presented in Table 4.6.6, which contains the date of activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report (EnSafe, 1998).*

Table 4.6.6
Summary of AOC 526
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 – 1997	Site Investigation of soil and groundwater.	
		Round 1 **Soil:** 8 surface borings (0 to 1 foot) 8 subsurface borings (3 to 5 feet) (526SB002 – 526SB009): Cyanide, organotin, metals, pesticides/PCBs, SVOCs, and VOCs (1 duplicate sample collected for herbicides, SVOCs, VOCs, cyanide, hexavalent chromium, organotin, dioxins, metals, organophosphate pesticides, and pesticides/PCBs)	***Round 1*** **Groundwater:** 2 shallow wells and 1 deep well (526001, 526002, and 52601D): chloride, cyanide, organotin, sulfate, metals, pesticides/PCBs, SVOCs, VOCs, and TDS

Table 4.6.6
Summary of AOC 526
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
	1995 - 1997	***Round 2*** **Soil:** No soil samples were collected.	***Round 2*** **Groundwater:** 2 shallow wells and 1 deep well (526001, 526002, and 52601D): chloride, sulfate, metals, SVOCs, VOCs, TDS
	1995 - 1997	***Round 3*** **Soil:** No soil samples were collected.	***Round 3*** **Groundwater:** 2 shallow wells and 1 deep well (526001, 526002, and 52601D): chloride, sulfate, metals, and TDS.
	1995 – 1997	***Round 4*** **Soil:** No soil samples were collected.	***Round 4*** **Groundwater:** 2 shallow wells and 1 deep well (526001, 526002, and 52601D): chloride, sulfate, metals, and TDS

Nature and Extent of Contaminants

Approximately 12 sample locations associated with AOC 526 were evaluated for the presence of contaminants between 1995 and 1997. All sample locations associated with AOC 526 are within the boundaries of Drainage Basin 20. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential concern at the site. Of particular interest were detections of BEQs in surface soil; and thallium in groundwater.

4.6.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at manhole 20/5 on February 7, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 20 into the Cooper River. Analytical detections for sample EFF014 are presented in Table 4.6.7.

Table 4.6.7
Storm Water Effluent Sampling Results
Drainage Basin 20

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
20	20/5	EFF014	**Aluminum**	**3,600**	**3,277**	**NL**	**Yes**
			Arsenic	4.00	6.88	36	No
			Barium	44	60.31	NL	No
			Beryllium	0.15	0.41	NL	No
			Calcium*	50,000	53,455	NL	No
			Chromium	11	13.00	50	No
			Cobalt	1.20	2.00	NL	No
			Copper	35	41.98	2.90	No
			Iron	**5,100**	**4,134**	**NL**	**Yes**
			Lead	**38**	**33.63**	**8.50**	**Yes**
			Magnesium*	10,000	49,255	NL	No
			Manganese	**110**	**74.52**	**NL**	**Yes**
			Nickel	6.00	5.14	8.30	No
			Potassium*	4,400	23,678	NL	No
			Sodium*	74,000	395,333	NL	No
			Thallium	5.50	5.77	21.30	No
			Vanadium	14	15.59	NL	No
			Zinc	**530**	**307.83**	**86**	**Yes**
			2,4-Dimethylphenol	**1.00**	**NL**	**NL**	**Yes**
			bis(2-Ethylhexyl) phthalate	**2.60**	**NL**	**NL**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.6.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 20. The Zone J data evaluation resulted in three possible outcomes based on the available data present for Drainage Basin 20. Table 4.6.8 summarizes the migration pathway scenarios.

Table 4.6.8
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 20

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	Yes
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	Yes
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.6.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS, seven buildings (NH-52, NH-54, NH-72, NH-1137, NH-1150, 81) were identified with the possible release of boiler blowdown into the storm water sewer system. The following chemicals may have been used for the treatment of water in the boiler used at these facilities: caustic soda, sodium, sulfite, disodium phosphate, and cyclohexylamine. Boiler waste water containing these chemicals is typically discharged to the storm water sewer system according to Public Works Utilities Department personnel. In 1990, two gallons of POL were released in the vicinity of Building 223 according to Environmental Incident Report #90-47. Building 223 is located within the boundaries of Drainage Basins 20 and 22 and it was not known at the time of the release if any of the release reached the storm water sewer system. Another facility within Drainage Basin 20, NSC 66, stored submarine and ship parts and according to the EBS a Hazardous Materials Report stated that blasting grit was packed in the storm drains and subsequently the areas were cleaned up.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF014 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at this facility.

4.6.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that 73 of 185 catch basins are near surface soil sample locations associated with SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zones B, C, and E background concentrations and the ecological risk based screening criteria identified sample location areas illustrated in Figure 4-6A source consistent with EFF014 COPCs for entry into the storm sewer system. A summary of this evaluation is provided in Table 4.6.9.

Table 4.6.9
Drainage Basin 20
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Value (mg/kg)	Distance to Catch Basin ft.
20/9/2-D	047SB006	Iron	12,100	7,696 (BKG)	110
20/13/1-B	047SB005	bis(2Ethylhexyl)phthalate	0.42	0.182 (EPA SSV)	99
20/14-B	047SB007	Iron	69,300	7,696 (BKG)	44
		Lead	1,120	7.40 (BKG)	
		Manganese	331	86 (BKG)	
		Zinc	1,100	152 (BKG)	
	047SB010	Aluminum	11,800	9,976 (BKG)	150
		Iron	8,650	7,696 (BKG)	
20/16/2/1-B	517SB002	bis(2Ethylhexyl)phthalate	0.54	0.182 (EPA SSV)	85
20/16/2-A	518SB002*	bis(2Ethylhexyl)phthalate	0.49	0.182 (EPA SSV)	173
	518SB003*	bis(2Ethylhexyl)phthalate	0.91	0.182 (EPA SSV)	135
20/16-B	047SB008	Iron	8,290	7,696 (BKG)	143
		Zinc	505	152 (BKG)	
	047SB009	Lead	312	138 (BKG)	267
		Zinc	312	152 (BKG)	
20/9/16-E	508SB002	Lead	180	138 (BKG)	55
20/9/6-A1	515SB001	Lead	324	7.40 (BKG)	70
		Zinc	371	152 (BKG)	
	515SB002	Iron	11900	7,696 (BKG)	105
		Lead	339	7.40 (BKG)	
		Zinc	410	152 (BKG)	
	515SB003	Lead	334	7.40 (BKG)	118
		Zinc	286	152 (BKG)	

100 0 100 Feet

N

LEGEND

- Soil Linkage Sample
- Surface Soil Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-6A
Drainage Basin 20 (West)
Soil Sample Linkage Locations

November 2002	Zone J Main Project.apr

Table 4.6.9
Drainage Basin 20
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Value (mg/kg)	Distance to Catch Basin ft.
	515SB005	Lead	522	7.40 (BKG)	92
		Zinc	361	152 (BKG)	
	515SB006	Lead	180	7.40 (BKG)	110
		Zinc	313	152 (BKG)	
20/15-B	516SB001	Manganese	133	86 (BKG)	35
20/16/2/1-A	517SB003	Lead	194	7.40 (BKG)	90
20/16/2-A	518SB009	Zinc	155	152 (BKG)	100
	518SB010	Lead	750	7.40 (BKG)	66
		Zinc	174	152 (BKG)	
	518SBC06	Lead	766	7.40 (BKG)	46
	518SBC07	Lead	214	7.40 (BKG)	48
	518SBC08	Lead	149	7.40 (BKG)	35
	518SBC09	Lead	508	7.40 (BKG)	38
	518SBC10	Lead	645	7.40 (BKG)	57
	518SBC11	Lead	210	7.40 (BKG)	80
	518SBC13	Lead	176	7.40 (BKG)	73
	518SBC14	Lead	306	7.40 (BKG)	46

Notes:
* = Sample location is located under pavement and constituents from these locations most likely do not represent complete exposure pathways to the storm water system.

4.6.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 20 were reviewed. Portions of the storm water line leading to Outfall 20 pass through an area with groundwater linkage locations (Figure 4-6B). A summary of this evaluation is provided in Table 4.6.10.

100 0 100 Feet

N

LEGEND

- Soil Linkage Sample
- Surface Soil Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-6B
Drainage Basin 20 (East)
Soil Sample Linkage Locations

November 2002 | Zone J Main Project.apr

200 0 200 Feet

N

LEGEND

- Groundwater Linkage Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Naval Facilities Engineering Command · Southern Division

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-6C
Drainage Basin 20
Groundwater Sample Linkage Locations

November 2002 | Zone J Main Project.apr

Table 4.6.10
Drainage Basin 20
Scenario 1c Evaluation
Charleston Naval Complex, South Carolina

Drainage Basin	Well ID	COPCs Consistent w/EFF014	Concentration (µg/L)	Screening Value (µg/L)	Distance to Sewer Line
20	047005	Aluminum	7,780	578 (BKG)	170 ft Upgradient
		Iron	5,700	3,438 (BKG)	
	047009	Iron	5,850	3,438 (BKG)	14 ft. Upgradient
	047010	Iron	12,100	3,438 (BKG)	300 ft Upgradient
	047015	Iron	31,400	3,438 (BKG)	160 ft. Upgradient
	047002	Iron	22,600	3,438 (BKG)	20 ft Downgradient
	047011	Aluminum	622	578 (BKG)	20 ft Downgradient
		Iron	21,700	3,438 (BKG)	
	047012	Iron	6,800	3,438 (BKG)	130 ft Downgradient
	047013	Iron	11,100	3,438 (BKG)	300 ft Downgradient

4.6.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 20.

4.6.4 Summary of Potential COPCs

Table 4.6.11 summarizes the potential COPCs that have been included for further characterization during the COPC Refinement process for the Cooper River.

Table 4.6.11
Summary of Potential COPCs
Drainage Basin 20

Potential COPC	Pathway of Concern
Aluminum	Scenario 1c
Iron	Scenario 1b Scenario 1c
Lead	Scenario 1b
Zinc	Scenario 1b

Table 4.6.11
Summary of Potential COPCs
Drainage Basin 20

Potential COPC	Pathway of Concern
bis(2-Ethylhexyl)phthalate	Scenario 1b

4.7 Drainage Basin 22

Drainage Basin 22 encompasses approximately 6.5 acres within Zone E and 1.0 acres within Zone B. The northwest area of Drainage Basin 22 extends into Zone B. Land cover within the basin consists of approximately 25% paved surfaces, 45% covered by building foundations, and 20% unpaved surfaces (i.e., mostly grass). Most storm water runoff within the drainage basin is directed to at least one of the 39 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 22.

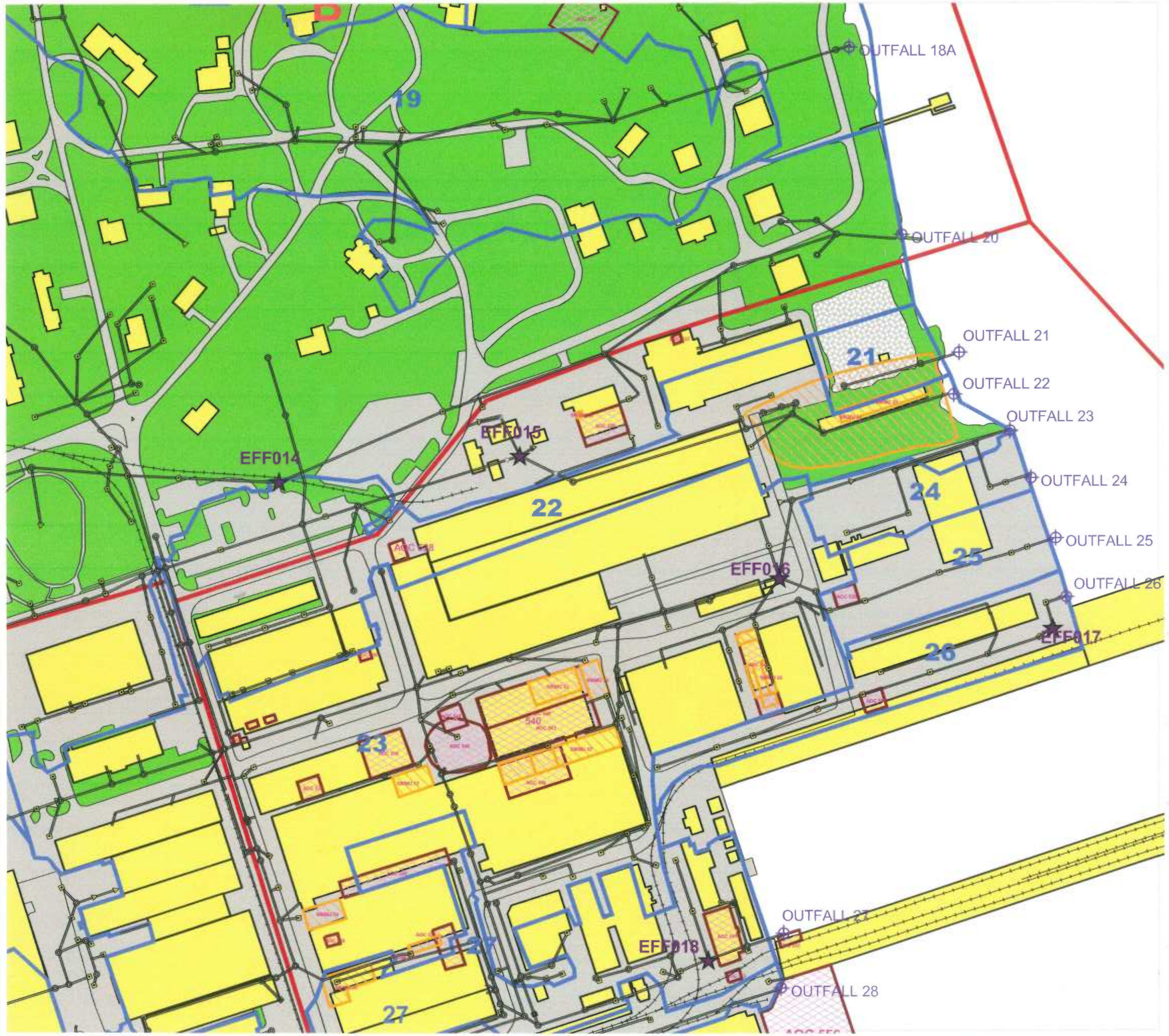
Figure 4-7 illustrates the area encompassing Drainage Basin 22 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.7.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are three SWMUs/AOCs partially or completely within the boundaries of Drainage Basin 22. The sites are listed in Table 4.7.1 along with the current status. These potential source areas include SWMU 21 (Waste Paint Storage Pad) and SWMU 54 (Former Abrasive Blast Area). It should be noted that SWMU 21 is completely encompassed by SWMU 54. The majority of SWMU 21 is located in Drainage Basin 22 with the northern edge of SWMU 21 extending into Drainage Basin 21. Approximately 70% of SWMU 54 is located within the boundaries of Drainage Basin 22, the remaining 30% is located in Drainage Basin 21. The other potential source area is AOC 528 (Steam Cleaning Shop) located entirely within Drainage Basin 22. All sites listed were included in the Zone J data evaluation.

Table 4.7.1
Drainage Basin 22 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 21	Waste Paint Storage Pad	RFI complete; IM complete; CMS in progress
SWMU 54	Former Abrasive Blast Area	RFI in progress; IM complete
AOC 528	Steam Cleaning Shop	RFI in progress



N

200 0 200 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-7
Drainage Basin 22

November 2002 | Zone J Main Project.apr

4.7.1.1 SWMU 21 and SWMU 54

Site Description and History

SWMU 21 and SWMU 54 were combined into one investigative unit because of their close proximity. The sites are located in an area bound by gravel, pavement, and Building 223 to the north; the Cooper River to the east; pavement and Building 239 to the south; and Building 59 and 2A to the west. SWMU 21 consists of a 20-foot by 180-foot concrete pad originally constructed in 1942 and formerly used to store containerized paint wastes generated by ship repair and overhaul operations. SWMU 54 was an area formerly used for the abrasive blasting of ship components and hull sections. Additionally, ship components and anchor chains were painted in this area.

Based on RFI analytical results, several COCs were identified in soil requiring further evaluation through the CMS process. An IM completed by the DET in1996, resulted in the removal of all visible spent abrasive blast residue from exposed surfaces of soil, asphalt, concrete, and to the extent possible, under concrete slab (SWMU 21). Approximately 18.6 tons of lead-contaminated material was removed and transported to Chem-Met Services in Wyandotte, Michigan, a permitted treatment, storage, and disposal facility. Approximately 1443.8 tons of non-hazardous material was transported to Oak Ridge (Chambers) Landfill in Dorchester County, South Carolina. The IM noted that the concrete slab (SWMU 21) was not the target of remedial actions and no follow-up was recommended.

Previous Investigations

A summary of investigative activities is presented in Table 4.7.2, which contains the date of the activities, number of soil, sediment, and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.7.2
Summary of SWMU 21 and SWMU 54 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Field Investigation	1988	Field investigation for Interim Status	No information available.

Table 4.7.2
Summary of SWMU 21 and SWMU 54 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		Unit RCRA Closure	
Preliminary RFI Investigation (EnSafe)	1993	Preliminary RFI Field Activities	
		Soil: **SWMU 21**: 3 surface borings (0 to 1 foot) (S21SB001 - S21SB003): metals and cyanide 3 surface borings (0 to 1 foot) (S21S0001 - S21S0003): VOCs, SVOCs, and metals 9 surface borings (0 to 1 foot) (021SB001-021SB002): SVOCs, VOCs (021SB003 – 021SB009): metals, SVOCs, and VOCs 2 subsurface borings (3 to 5 feet) (S21SB001 and S21SB002): metals, SVOCs, Organotins 8 subsurface borings (3 to 5 feet) (021SB001and 021SB002 and 021SB004-021SB009): metals, SVOCs, VOCs	
RFI (EnSafe)	1995-1996	Site investigation of soil, groundwater, and sediment collected at SWMU 21 and SWMU 54 to confirm results from 1993 investigation.	
		Round 1 **Soil**: **SWMU 54**: 40 surface borings (0 to 1 foot) (054SB001 - 054SB033, 054SB035 – 054SB040): metals, SVOCs, and Organotins (054SB034): VOCs, metals, SVOCs, and Organotins 35 subsurface borings (3 to 5 feet) (054SB001 - 054SB033, 054SB035, 054SB040): metals, SVOCs, VOCs 9 duplicates collected for the same parameters **Sediment**:	***Round 1*** **Groundwater** **SWMU 21**: 3 shallow wells (021001 - 021003): VOCs, SVOCs, pesticides/PCBs, metals, cyanide, chlorides, sulfates, TDS, and organotins **SWMU 54**: 3 shallow wells (054001 – 054003): VOCs, SVOCs, pesticides/PCBs, metals, cyanide, chlorides, sulfates, TDS, and organotins 3 duplicates were collected for the same parameters

Table 4.7.2
Summary of SWMU 21 and SWMU 54 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		4 sediment samples and one duplicate (054M0001 - 054M0004): SVOCs, metals, and organotins.	
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** **SWMU 21** (021001 – 021003): VOCs, metals, chloride, TDS, and sulfates **SWMU 54** (054001 – 054003): VOCs, metals, chloride, TDS, and sulfates
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** **SWMU 21** (021003): metals, chloride, TDS, and sulfates **SWMU 54** (054002): metals, chloride, TDS, and sulfates
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** **SWMU 21** (021003): metals, chloride, TDS, and sulfates **SWMU 54** (054002): metals

Nature and Extent of Contaminants

Approximately 65 sample locations associated with SWMUs 21 and 54 were evaluated for the presence of contaminants between 1993 and 1997. Of these 65, approximately 46 locations are within the boundaries of Drainage Basin 22. Surface, subsurface, sediment and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to storage of containerized paint waste and abrasive blast media associated with previous activities at the site. Of particular interest were detections of antimony, arsenic, beryllium, cadmium, lead and BEQs in soil; and antimony and thallium in groundwater. Based on analytical results, the site was recommended for CMS for soil and groundwater.

During the CMS, remedial goal objectives were developed based on the analytical results and the human health risk assessment for the site. The IM completed by the DET in 1996 indicated that visible spent abrasive blast residue from all exposed surfaces of soil, asphalt, and concrete, and to the extent possible, under concrete slab (SWMU 21) was removed.

4.7.1.2 AOC 528

Site Description and History

AOC 528 consists of a former steam cleaning shop used to clean boiler parts. AOC 528 is associated with Building 1453. The site is located in an area bound by Pine Road to the north; Building 59 to the east; Building 2 to the south; and Avenue B to the west. Boiler tubes were steam-rinsed at AOC 528 after the tubes were cleaned by a bath of kerosene at Building 59. Although this operation did not generate hazardous waste, it did produce approximately 800 gallons of contaminated kerosene semi-annually. The contents of the steam cleaning operation were discharged to the sanitary sewer. Before installation of the sanitary sewer, waste was discharged to the Cooper River via the combined sewer system.

Previous Investigations

A summary of investigative activities is presented in Table 4.7.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.7.3
Summary of AOC 528 Investigation
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site investigation of soil, and groundwater.	
RFI (EnSafe)	1995	**Soil**: 4 surface borings (0 to 1 foot) (528SB001, 528SB003 - 528SB004): VOCs, SVOCs, and pH (528SB002): VOCs and SVOCs 4 subsurface borings (3 to 5 feet)	**Groundwater:** No Groundwater Samples Collected.

Table 4.7.3
Summary of AOC 528 Investigation
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		(528SB001 - 528SB004): VOCs and SVOCs (1 duplicate collected for the same parameters)	
RFI (EnSafe)	1996	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 1 shallow well (528001): VOCs, SVOCs, metals, pH, chloride, sulfates, and TDS
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (528001): metals, pH, chloride, sulfates, and TDS
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 1 shallow well (528001): metals, pH, chloride, sulfates, and TDS
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (528001): metals, pH, chloride, sulfates, and TDS

Nature and Extent of Contaminants

Five sample locations associated with AOC 528 were evaluated for the presence of contaminants in 1996 and 1997. All five locations are within the boundaries of Drainage Basin 22. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the former steam cleaning shop used to clean boiler parts. BEQs were detected in one AOC 528 surface soil sample at concentrations above their residential remedial goal options (RGOs); however, the mean risk was calculated below 1E-06, therefore, no further action was recommended.

4.7.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 22/6 on June 18, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 22 into the Cooper River. Analytical detections for sample EFF015 are presented in Table 4.7.4.

Table 4.7.4
Storm Water Effluent Sampling Results
Drainage Basin 22

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
22	22/6	EFF015	Aluminum	1,300	3,277	NL	No
			Barium	22	60.31	NL	No
			Cadmium	0.75	1.29	9.30	No
			Calcium*	8,500	53,455	NL	No
			Chromium	7.20	13	50	No
			Cobalt	1.20	2.00	NL	No
			Copper	36	41.98	2.90	No
			Iron	3,900	4,134	NL	No
			Lead	33	33.63	8.50	No
			Magnesium*	5,200	49,255	NL	No
			Manganese	**88**	**74.52**	**NL**	**Yes**
			Nickel	5.80	5.14	8.30	No
			Potassium*	2,700	23,678	NL	No
			Sodium*	45,000	395,333	NL	No
			Vanadium	7.90	15.59	NL	No
			Zinc	**1,000**	**307.83**	**86**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.7.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 22. Table 4.7.5 summarizes the migration pathway scenarios.

Table 4.7.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 22

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	No
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No

Table 4.7.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 22

Scenario	Pathway Description	Is Pathway Complete?
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.7.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. In 1990, two gallons of POL were released in the vicinity of Building 223 according to Environmental Incident Report #90-47. Building 223 is located within the boundaries of Drainage Basins 20 and 22 and it was not known at the time of the release if any of the release reached the storm water sewer system. Review of the data for EFF015 did not identify contaminants that may be associated with residuals from the 1990 release. Therefore, this pathway is considered incomplete.

4.7.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 39 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone E background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source of manganese, or zinc in the storm sewer system.

4.7.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and

were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 22 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with manganese, or zinc intercepting the storm water drainage pipeline within Drainage Basin 22.

4.7.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 22.

4.7.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 22 due to a lack of an upland terrestrial source identification.

4.8 Drainage Basin 23

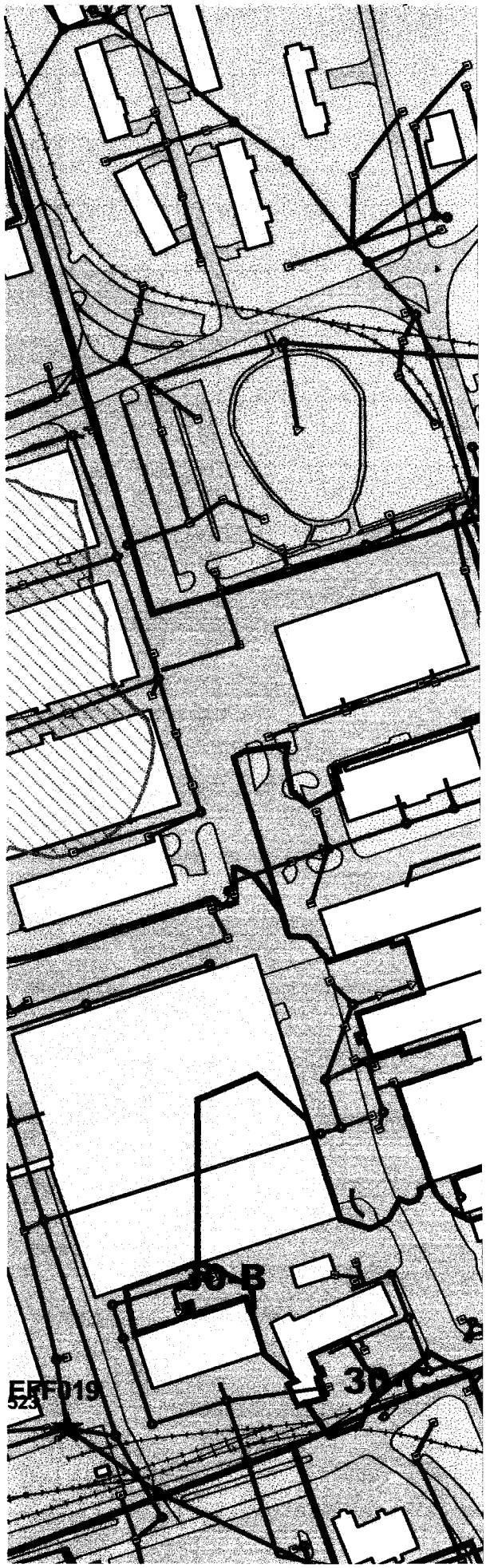
Drainage Basin 23 encompasses approximately 22 acres within Zone E in the central section of the CNC. Land cover within the basin consists of approximately 10% paved surfaces, 5% unpaved surfaces (i.e., mostly grass), and 85% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the 95 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 23.

Figure 4-8 illustrates the area encompassing Drainage Basin 23 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.8.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are 20 AOCs/SWMUs that are partially or completely within the boundary of Drainage Basin 23. The sites are listed in Table 4.8.1, along with the current status of each site. The potential source areas include SWMU 22 (Old Plating Shop Wastewater Treatment System (WWTS)), SWMU 23 (New Plating Shop (WWTS)), SWMU 25 (Old Plating Operation), SWMU 63 (Battery Charging Station), SWMU 65 (Lead Storage Area), SWMU 67 (Mercury Gauge Room), SWMU 70 (Dip Tank Area), AOCC 530 (Paint and Oil Storage), AOC 531 (Substation and Storage), AOC 538 (Building 6 Forge Shop), AOC 539 (Building 6 Propeller Shop), AOC 540 (Plating Plant, Building 226), AOC 541 (Oil Storage Shops), AOC 542 (Old OxyAcetylene Plant and Paint Shop), AOC 543 (Former Building 1026), AOC 544 (Building 221 Pickling Plant), AOC 548 (Building 5 Elevator), AOC 549 (Scrap Yard), AOC 550 (Boiler House), and AOC 554 (Former Paint Shop).

SWMU 25 is located in Drainage Basin 27, however, one sample location associated with this site falls within the boundaries of Drainage Basin 23. AOC 549 transcends the boundaries of Drainage Basin 23 into Drainage Basin 27. AOC 550 is located in Drainage Basin 26; however, one sample point associated with this site falls within the boundaries of Drainage Basin 23. The southern site boundary of AOC 554 transcends Drainage Basin 23 into Drainage Basin 27, but all sample points associated with the site are within the boundaries of Drainage Basin 23.



N

200 0 200 Feet

LEGEND

★ Storm Water Effluent Sample

Drainage Basin

Storm Water Outfall

Storm Water Lines

Storm Water Catchbasin

Storm Water Drain Line

Storm Water Ditch

Groundcover

Gravel

Pavement

Soil/Grass

Wetland

SWMU/AOC

AOC Area

SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-8
Drainage Basin 23

January 2003	Zone J Main Project.apr

Table 4.8.1
Drainage Basin 23 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 22	Old Plating Shop Wastewater Treatment System	Draft RFI Report
SWMU 23	New Plating Shop Wastewater Treatment System	Draft RFI Report; Phase I and II CMS Work Plan
SWMU 25	Old Plating Operation	Draft RFI Report
SWMU 63	Battery Charging Station	Draft RFI Report
SWMU 65	Lead Storage Area	Draft RFI Report
SWMU 67	Mercury Gauge Room	Draft RFI Report; RFI Addendum
SWMU 70	Dip Tank Area	Draft RFI Report; Phase I and II CMS Work Plan
AOC 530	Paint and Oil Storage	Draft RFI Report; RFI Report Addendum; CMS Work Plan; CMS Report
AOC 531	Substation and Storage	Draft RFI Report; RFI Report Addendum; CMS Work Plan; CMS Report
AOC 538	Building 6 Forge Shop	Draft RFI Report
AOC 539	Building 6 Propeller Shop	Draft RFI Report
AOC 540	Plating Plant, Building 226	Draft RFI Report
AOC 541	Oil Storage Shops	Draft RFI Report
AOC 542	Old OxyAcetylene Plant and Paint Shop	Draft RFI Report
AOC 543	Former Building 1026	Draft RFI Report
AOC 544	Building 221 Pickling Plant	Draft RFI Report; Sampling and Analysis Plan
AOC 548	Building 5 Elevator	Draft RFI Report
AOC 549	Scrap Yard	Draft RFI Report
AOC 550	Boiler House	Draft RFI Report; RFI Addendum Report
AOC 554	Former Paint Shop	Draft RFI Report

4.8.1.1 SWMU 22, SWMU 25, and AOC 554
Site Description and History

SWMU 22, SWMU 25 and AOC 554 were combined into one investigative unit because of their close proximity. These sites are located north of the intersection of McMillan and Hobson Avenues in the central portion of Zone E. These sites are bounded by Building 5 to the north, Building 57 to the south, Hobson Avenue to the west, and Avenue "B" to the east.

SWMU 22 was originally constructed in 1972 and consisted primarily of a 5-foot by 5-foot by 8-foot concrete collection sump partitioned in half. One side accumulated acidic wastewater while the other side collected cyanide and alkaline wastewater. This unit became inactive around 1983 when the new metal plating waste-treatment facility began operation.

SWMU 25 consisted of former electroplating operation associated with Building 44 with approximately 40 metal tanks that contained solutions used in plating processes until operations ceased in 1983. The process tanks and associated equipment were removed in 1995 during closure operations of Charleston Naval Shipyard. SWMU 25 has been the subject of three IM activities conducted by the DET in 1997, 1998, and 1999. Building 44 was demolished between February and April 1997, generating approximately 330 tons of contaminated building material. The material was transported to the Laidlaw Environmental Services landfill in Pinewood, South Carolina for disposal. Between June and August 1998, 3.1 tons of chromium contaminated fluid was removed from the electrical vault beneath Building 44. This waste was transported to Chem-Met Services for disposal. The final IM consisted of the removal of the electrical vault and associated cables. The excavation was conducted in July 1999 generating approximately 25 tons of chromium contaminated debris. The debris was transported to the Safety Kleen Inc. landfill in Pinewood, South Carolina.

AOC 554 is the location of former Building 1003 and was used as a paint shop from approximately 1909 to 1940. No additional information regarding size, design features, or operating practices is known about this unit.

Previous Investigations

A summary of investigative activities is presented in Table 4.8.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone E RFI Report*.

Table 4.8.2
Summary of SWMU 22, SWMU 25, and AOC 554 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Field Investigation	1988, 1991	Field Investigation for Interim Status Unit RCRA Closure	Soil, waste material, and equipment were sampled. No other information available.
Preliminary RFI	1993	Site Investigation of soil.	
		Soil:	**Groundwater**:

Table 4.8.2
Summary of SWMU 22, SWMU 25, and AOC 554 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		SWMU 22 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (S22B01, S22B02): SVOCs, VOCs, metals **SWMU 25** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (025SB001 - 025SB003): metals, SVOCs, VOCs	No Groundwater Samples Collected.
RFI (EnSafe)	1995 – 1997	Site investigation of soil and groundwater	
	1995	***Round 1*** **Soil**: **SWMU 22** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (022SB001, 022SB002): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide (1 duplicate collected for the same parameters) **AOC 554** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (554SB001, 554SB002): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide **Sediment**: 1 sediment sample (025M0001): metals, SVOCs, VOCs, pesticides/PCBs, cyanide	***Round 1*** **Groundwater**: No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** **SWMU 25** 10 surface borings (0 to 1 foot) (025SB004 - 025SB013): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide (2 duplicates collected for the same parameters) 9 subsurface borings (3 to 5 feet) (025SB004 – 025SB006, 025SB008	***Round 2*** **Groundwater:** **SWMU 25** 4 shallow wells (025001 – 025004): VOCs, SVOCs, pesticides/PCBs, organotins, metals, cyanide, and general chemistry

Table 4.8.2
Summary of SWMU 22, SWMU 25, and AOC 554 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		– 025SB013): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide (1 duplicate collected for the same parameters)	
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** **SWMU 25** 4 shallow wells (025001 – 025004): VOCs, SVOCs, pesticides/PCBs, metals, and general chemistry
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** **SWMU 25** 4 shallow wells (025001 – 025004): VOCs, pesticides/PCBs, metals, and general chemistry
RFI (EnSafe)	1997	***Round 5*** **Soil:** **SWMU 25** 14 surface borings (0 to 1 foot) 14 subsurface borings (3 to 5 feet) (025SB014 – 025SB027): metals, cyanide	***Round 5*** **Groundwater:** **SWMU 25** 4 shallow wells (025001 – 025004): VOCs, pesticides/PCBs, metals, and general chemistry
RFI (EnSafe)	1998	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** **SWMU 25** 4 shallow wells (025001 – 025004): VOCs
RFI (EnSafe)	1998	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** **SWMU 25** 4 shallow wells (025001 – 025004): VOCs
CH2M-Jones	2001	**Soil:** No Soil Samples Collected.	**Groundwater:** 4 shallow wells (025001L - 025004L): Dissolved metals, hexavalent chromium, VOCs

Nature and Extent of Contaminants

Thirty-eight sample locations associated with SWMU 22, SWMU 25, and AOC 554 were evaluated for the presence of contaminants in 1993 through 2001. Of the 38 locations, 10 are within the boundaries of Drainage Basin 23. Surface, subsurface, groundwater, and sediment

samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the wastewater treatment, plating, and paint operations associated with previous activities at the site. Of particular interest were detections of arsenic, cadmium, chromium, lead, dieldrin, tetrachloroethene, and BEQs in soil; antimony, cadmium, chromium, lead, nickel, thallium, trichloroethene, tetrachloroethane, alpha and gamma chlordane in groundwater. Surface and subsurface soil, sediment, and shallow groundwater were recommended for CMS.

4.8.1.2 SWMU 23, SWMU 63, AOC 540, AOC 541, AOC 542, and AOC 543
Site Description and History

SWMU 23, SWMU 63, AOC 540, AOC 541, AOC 542, and AOC 543 were combined into one investigative unit because of their close proximity. These sites are located in an area along the south side of Second Street encompassing Building 226, the open paved area on the south side of the intersection of Avenue "B" and Second Street, and the southwest corner of the intersection of Avenue "A" and Second Street. This area is in the north-central portion of Zone E and is bounded by Building 2 to the north, Building 3 to the south, Building 6 to the west, and Building 56 to the east.

SWMU 23 is the new WWTS on the northeast corner of Building 226. The treatment building is a concrete structure built around 1983 to replace an existing system. The new WWTS handled cadmium and chrome effluent and acid/alkali effluent from metal plating. The treatment system consisted of rinse water pumps, holding tanks, transfer pumps, a clarifier, a neutralization tank, and a plate and frame filter press. SWMU 63, a battery charging station that was operated from 1941 to approximately 1970 was located in former Building 73. No records have been found providing specific information on its operating practices. More recently this site was used by naval base as Building 226, a plating facility.

AOC 540 is the location of a former plating plant in Building 226 and was constructed in 1976. Operations consisted of a pump and valve test area, a plating area, and a hydraulic repair area. A wet scrubber, 120 plating dip tanks, a sludge pit, and waste treatment facility were associated with this facility. An oil/water separator and 300-gallon fuel oil tank were in operation on the

southwest side of Building 226. AOC 541, an oil storage house, was in former Building 38, and operated from 1909 until 1939, but was demolished in 1970. The site is currently an asphalt parking lot between Building 6 and Building 226. AOC 542, a paint shop and oxy-acetylene plant, was located at former Building 22. Operations of the oxyacetylene plant began here in 1922, and in 1943, the building was converted into a paint shop and served that purpose until it was demolished in 1976. During this period, chemical and abrasive paint stripping were also conducted here. Currently this site is an open paved area between Buildings 3, 6, and 226. AOC 543 is the site of former Building 1026 that was constructed in 1922 and used as a storehouse until 1943. From 1943 to 1955, the site was a field electric shop. From 1955 until approximately 1970, this site was used as a storehouse again. Currently this site is occupied by Building 226.

Previous Investigations

A summary of investigative activities is presented in Table 4.8.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone E RFI Report*.

Table 4.8.3
Summary of SWMU 23, SWMU 63, AOC 540, AOC 541, AOC 542, and AOC 543 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 – 1997	Site investigation of soil and groundwater	
	1995	***Round 1*** **Soil:** ***SWMU 23*** 3 surface borings (0 to 1 foot) (023SB001 – 023SB003): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide 2 subsurface borings (3 to 5 feet) (023SB001, 023SB002): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide (1 duplicate collected for the same parameters)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Table 4.8.3
Summary of SWMU 23, SWMU 63, AOC 540, AOC 541, AOC 542, and AOC 543 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		SWMU 63 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (063SB001 - 063SB003): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide **AOC 540** 1 surface borings (0 to 1 foot) 1 subsurface boring (3 to 5 feet) (540SB001): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide (1 duplicate collected for the same parameters) **AOC 541** 1 surface boring (0 to 1 foot) (541SB001): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide **AOC 542** 7 surface borings (0 to 1 foot) (542SB001 – 542SB007): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide 5 subsurface borings (3 to 5 feet) (542SB001 - 542SB003, 541SB005, 542SB006): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide (1 duplicate collected for the same parameters) **AOC 543** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (543SB001 - 543SB004): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide (3 duplicates collected for the same parameters)	
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** **SWMU 23** 1 shallow well (023001): VOCs, SVOCs, pesticides/PCBs, organotins, metals,

Table 4.8.3
Summary of SWMU 23, SWMU 63, AOC 540, AOC 541, AOC 542, and AOC 543 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			cyanide and general chemistry **SWMU 63** 2 shallow wells (063001 – 063002): VOCs, SVOCs, pesticides/PCBs, organotins, metals, cyanide and general chemistry **AOC 542** 4 shallow wells (542001 – 542004): VOCs, SVOCs, pesticides/PCBs, organotins, metals, cyanide and general chemistry **AOC 543** 1 shallow well (543001): VOCs, SVOCs, pesticides/PCBs, organotins, metals, cyanide and general chemistry
RFI (EnSafe)	1996	***Round 3*** **Soil:** **SWMU 23** 1 surface boring (0 to 1 foot) (023SB004): metals, SVOCs **AOC 543** 1 surface borings (0 to 1 foot) (543SB002): SVOCs	***Round 3*** **Groundwater:** **SWMU 23** 1 shallow well (023001): SVOCs, metals, and general chemistry **SWMU 63** 2 shallow wells (063001 – 063002): metals, and general chemistry **AOC 542** 4 shallow wells (542001 – 542004): VOCs, SVOCs, metals, and general chemistry **AOC 543** 1 shallow well (543001): metals, and general chemistry
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** **SWMU 23** 1 shallow well (023001): metals, and general chemistry **SWMU 63**

Table 4.8.3
Summary of SWMU 23, SWMU 63, AOC 540, AOC 541, AOC 542, and AOC 543 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			2 shallow wells (063001 – 063002): metals, and general chemistry **AOC 542** 4 shallow wells (542001 – 542004): metals, and general chemistry **AOC 543** 1 shallow well (543001): metals, and general chemistry
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** **SWMU 23** 1 shallow well (023001): metals, and general chemistry **SWMU 63** 2 shallow wells (063001 – 063002): metals, and general chemistry **AOC 542** 4 shallow wells (542001 – 542004): metals, and general chemistry **AOC 543** 1 shallow well (543001): metals, and general chemistry
CH2M-Jones	2001	***Round 1*** **Soil:** **AOC 541** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (266SB005 – 266SB008): VOCs, SVOCs	***Round 1*** **Groundwater:** **AOC 541** 4 shallow wells (26601L, 26602L, 26605L – 26606L): VOCs, SVOCs, and general chemistry

Nature and Extent of Contaminants

Thirty-seven sample locations associated with SWMU 23, SWMU 63, AOC 540, AOC 541, AOC 542, and AOC 543 were evaluated for the presence of contaminants in 1995 through 2001. Of the 37 locations, 36 are within the boundaries of Drainage Basin 23. Surface, subsurface, and

groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the wastewater treatment, battery charging, plating, paint, and pickling operations associated with previous activities at the site. Of particular interest were detections of antimony, Aroclor-1254, and BEQs in soil and thallium, in groundwater. Surface soil and shallow groundwater were recommended for CMS.

4.8.1.3 SWMU 65 and AOC 544
Site Description and History

SWMU 65, AOC 544, and AOC 546 were combined into one investigative unit because of their close proximity. The sites are associated with Building 221 and are bound to the north by Second Street, Building 74 to the east, Pier C to the south, and Building 56 to the west. SWMU 65 consists of a former lead storage area in which lead blankets and shielding materials were stored on pallets and shelves inside and on a paved area south of Building 221. The majority of lead was encased in rubber but some exposed lead was stored beneath tarps inside the building. This site was also used as a staging area for scrap lead awaiting disposal. AOC 544 consisted of an open-air facility using a series of chemical baths and water rinses in the pickling process. Pickling bath solutions discharged into the Cooper River via the storm drain system and was discontinued in 1984.

Previous Investigations

A summary of investigative activities is presented in Table 4.8.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.8.4
Summary of SWMU 65 and AOC 544 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 – 1997	Site investigation of soil and groundwater	
	1995	***Round 1*** **Soil:**	***Round 1*** **Groundwater:**

Table 4.8.4
Summary of SWMU 65 and AOC 544 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		SWMU 65 6 surface borings (0 to 1 foot) (065SB001 - 065SB006): VOCs, SVOCs, pesticides/PCBs, organotins, metals, and cyanide 4 subsurface borings (3 to 5 feet) (065SB001, 065SB003, 065SB005, 065SB006): metals, SVOCs, VOCs, pesticides/PCBs, cyanide. (2 duplicates collected for the same parameters) * One subsurface soil sample (065SB00603 - 11.5 to 13.5 feet) and one free product sample (065SBFP602) were collected at 065SB006 after free product was noted during drilling. **AOC 544** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (544SB001 – 544SB004): metals, SVOCs, VOCs, pesticides/PCBs, organotins and cyanide	No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 6 shallow wells (065001 – 065005): VOCs, SVOCs, pesticides/PCBs, organotins, metals, cyanide and general chemistry (065006): VOCs, SVOCs, pesticides/PCBs, metals, cyanide and general chemistry
RFI (EnSafe)	1996	***Round 3*** **Soil:** **SWMU 65** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (065SB007 and 065SB008): metals, SVOCs	***Round 3*** **Groundwater:** 8 shallow wells (065001 – 065006): VOCs, SVOCs, pesticides/PCBs, dioxins, metals, cyanide and general chemistry (065007 – 065008): VOCs, SVOCs, pesticides/PCBs, metals, cyanide and general chemistry
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 6 shallow wells (065001 – 065006): VOCs, SVOCs, pesticides/PCBs, metals, and general chemistry

Table 4.8.4
Summary of SWMU 65 and AOC 544 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 8 shallow wells (065001 – 065006): VOCs, SVOCs, pesticides/PCBs, metals, and general chemistry (065007 – 065008): VOCs, SVOCs, pesticides/PCBs, metals, cyanide, and general chemistry
RFI (EnSafe)	1997	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 2 shallow wells (065007 – 065008): VOCs, SVOCs, and metals
RFI (EnSafe)	1997	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 2 shallow wells (065007 – 065008): VOCs, SVOCs, and metals
RFI (EnSafe)	1998	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** 8 shallow wells (065001 – 065008): VOCs
RFI (EnSafe)	1998	***Round 9*** **Soil:** No Soil Samples Collected.	***Round 9*** **Groundwater:** 8 shallow wells (065001 – 065008): VOCs

Nature and Extent of Contaminants

Twenty-one sample locations associated with SWMU 65 and AOC 544 were evaluated for the presence of contaminants in 1995 through 1998. Of the 21 locations, 16 are within the boundaries of Drainage Basin 23. Surface, subsurface, and groundwater were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the storage and staging of lead blankets, shielding materials, scrap lead, and pickling solutions associated with previous activities at the site. Of particular interest were detections of aldrin, dieldrin, arsenic, and BEQs in soil, and antimony, arsenic, beryllium, cadmium, chromium, lead, mercury, thallium, trichloroethene, and vinyl chloride in groundwater. Surface and subsurface soil and shallow and deep groundwater were recommended for CMS.

4.8.1.4 SWMU 67

Site Description and History

SWMU 67 is in the northeast portion of Building 3 in the central portion of Zone E and consists of a mercury gauge room (2nd floor), a former mercury gauge room (1st floor), and a mercury storage area (1st floor) used to conduct calibration and leak tests on mercury gauges.

Previous Investigations

A summary of investigative activities is presented in Table 4.8.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.8.5
Summary of SWMU 67 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 – 1997	Site investigation of soil and groundwater	
	1995	***Round 1*** **Soil**: 7 surface borings (0 to 1 foot) 7 subsurface borings (3 to 5 feet) (067SB001 - 067SB007): Mercury (1 duplicate collected for the same parameters)	***Round 1*** **Groundwater**: No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 2 shallow wells (067001 – 067002): metals and general chemistry
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (067001 – 067002): General chemistry
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (067001 – 067002): metals and general chemistry
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 2 shallow wells

Table 4.8.5
Summary of SWMU 67 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
		(067001 – 067002): metals and general chemistry

Nature and Extent of Contaminants

Nine sample locations associated with SWMU 67 were evaluated for the presence of mercury in 1995 through 1997. All nine locations are within the boundaries of Drainage Basin 23. Surface, subsurface, groundwater, and wipe samples were collected and analyzed for mercury in order to delineate the extent of potential contamination attributable to the storage and handling of mercury during previous activities at the site. Mercury was detected in three surface and 2 subsurface soil sampled at SWMU 67, however, no detection exceeded the screening objectives. Mercury was not identified as a contaminant of concern in soil or groundwater, therefore, no further action was recommended.

4.8.1.5 SWMU 70, AOC 548, and AOC 549

Site Description and History

SWMU 70, AOC 548, and AOC 549 were combined into one investigative unit because of their close proximity. These sites are located in an area that includes the northern edge of Building 5 and the southwestern edge of Building 3, including the alley between the two buildings. They are bound by Building 3 to the north, Building 5 to the south, Hobson Avenue to the west, and Third Street to the east. SWMU 70 is the former location of a dip tank used to treat wood with fire retardant until 1981. AOC 548 consists of an electric hydraulic elevator in a shaft that is paved on the bottom with approximately 8 inches of concrete a container that captured hydraulic fluid leaks and returned it to the main reservoir. AOC 549 consists of a former scrap yard north of Building 5 (1920s and 1930s) and is currently paved with concrete and asphalt.

Previous Investigations

A summary of investigative activities is presented in Table 4.8.6, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and

analytical methods performed during the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone E RFI Report*.

Table 4.8.6
Summary of SWMU 70, AOC 548, and AOC 549 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 - 1997	Site investigation of soil and groundwater	
		Round 1 **Soil:** **SWMU 70** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (070SB001 – 070SB004): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide **AOC 548** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (548SB001 – 548SB004): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide **AOC 549** 10 surface borings (0 to 1 foot) (549SB001 – 549SB010): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide 9 subsurface soil borings (549SB001-549SB004 and 549SB006 - 549SB010): metals, SVOCs, VOCs, pesticides/PCBs, organotins, and cyanide	***Round 1*** **Groundwater:** No Groundwater Sample Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** **SWMU 70** 2 shallow wells (070001 – 070002): metals, SVOCs, VOCs, pesticides/PCBs, organotins, cyanide, and general chemistry **AOC 549** 1 shallow well (549001): metals, SVOCs, VOCs, pesticides/PCBs, organotins, cyanide, and general chemistry
RFI (EnSafe)	1996	***Round 3*** **Soil:**	***Round 3*** **Groundwater:**

Table 4.8.6
Summary of SWMU 70, AOC 548, and AOC 549 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		AOC 549 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (549SB011 - 549SB013): metals, SVOCs (549SB014): metals, SVOCs, and general chemistry	**SWMU 70** 2 shallow wells (070001 – 070002): metals, SVOCs, VOCs, cyanide, and general chemistry **AOC 549** 1 shallow well (549001): metals, SVOCs, VOCs, and general chemistry
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** **SWMU 70** 2 shallow wells (070001 – 070002): metals, VOCs, and general chemistry **AOC 549** 1 shallow well (549001): metals, VOCs, and general chemistry
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** **SWMU 70** 2 shallow wells (070001 – 070002): metals, VOCs, and general chemistry **AOC 549** 1 shallow well (549001): metals, VOCs, and general chemistry
RFI Addendum (EnSafe)	1998	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** **SWMU 70** 2 shallow wells (070001 – 070002): VOCs **AOC 549** 1 shallow well (549001): VOCs
RFI Addendum (EnSafe)	1998	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** **SWMU 70** 2 shallow wells (070001 – 070002): VOCs **AOC 549** 1 shallow well (549001): VOCs
RFI Addendum	2000	***Round 8***	***Round 8***

Table 4.8.6
Summary of SWMU 70, AOC 548, and AOC 549 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
(EnSafe)		**Soil:** No Soil Samples Collected.	**Groundwater:** **SWMU 70** 1 shallow wells (070001): metals **AOC 549** 1 shallow well (549001): metals
CH2M-Jones	2001	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** **SWMU 70** 2 shallow wells (070001 – 070002): VOCs, Filtered metals, metals, general chemistry, methane, and carbon dioxide **AOC 549** 3 shallow wells (549001L): Dissolved metals, hexavalent chromium. (549002L and 549003L) Dissolved metals, hexavalent chromium, VOCs

Nature and Extent of Contaminants

Twenty-seven sample locations associated with SWMU 70, AOC 548, and AOC 549 were evaluated for the presence of contaminants between 1995 and 2001. Of these 27, approximately 20 locations are within the boundaries of Drainage Basin 23. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the former dip tank, hydraulic elevator, and former scrap yard, and previous activities at the site. Of particular interest were detections of copper, lead, and BEQs in soil; and antimony, cadmium, chromium, thallium, tetrachloroethene, trichloroethene, and vinyl chloride in groundwater. Surface soil, shallow groundwater, and deep groundwater were recommended for CMS.

4.8.1.6 AOC 530

Site Description and History

AOC 530 is in the southeast corner of Building 35 on the north side of the intersection of Hobson Avenue and Second Street. The site is bound by Building 35 to the north, Second Street to the south, Hobson Avenue to the west, and Avenue "B" to the east. AOC 530 was used for storage of paint, oil, and waste generated from the printing operations for Naval Publications (ferric chloride acid etching bath, lithographic developing solution, and photographic developing solution). The Publication and Printing Service was housed in Building 35 from 1949 until 1979. Most recently, Building 35 has been used as a training facility for welding students.

Previous Investigations

A summary of investigative activities is presented in Table 4.8.7, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.8.7
Summary of AOC 530 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1997	Site investigation of soil and groundwater	
	1996	***Round 1*** **Soil**: 8 surface borings (0 to 1 foot) (530SB001-530SB008): VOCs, SVOCs, and metals 5 subsurface borings (3 to 5 feet) (530SB001-530SB005): metals, SVOCs, and VOCs (1 duplicate collected for same parameters)	***Round 1*** **Groundwater**: No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 2 shallow wells (530001 – 530002): VOCs, SVOCs, metals, and general chemistry
RFI (EnSafe)	1996	***Round 3*** **Soil**: 3 surface borings (0 to 1 foot)	***Round 3*** **Groundwater:** 2 shallow wells

Table 4.8.7
Summary of AOC 530 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		(530SB009, 530SB011): metals, SVOCs (530SB010): metals, SVOCs, and general chemistry 3 subsurface soil borings (530SB009 - 530SB011): metals, SVOCs	(530001 – 530002): VOCs, SVOCs, metals, and general chemistry
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (530001 – 530002): VOCs, SVOCs, metals, and general chemistry
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 2 shallow wells (530001 – 530002): VOCs, SVOCs, metals, and general chemistry
RFI Addendum Work Plan (EnSafe)	1998	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 1 shallow well (530001): VOCs

Nature and Extent of Contaminants

Thirteen sample locations associated with AOC 530 were evaluated for the presence of contaminants between 1996 and 1998. All 13 locations are within the boundaries of Drainage Basin 23. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the storage of paint and oil and previous activities at the site. Of particular interest were detections of arsenic, lead, and BEQs in soil and thallium in groundwater. Surface soil, shallow groundwater, and deep groundwater were recommended for CMS.

4.8.1.7 AOC 531

Site Description and History

AOC 531 is Building 459 located off the southeast corner of Building 35 on the north side of the intersection of Hobson Avenue and Second Street. The site is bound by Building 35 to the north, Second Street to the south, Hobson Avenue to the west, and Avenue "B" to the east. AOC 531 was constructed in 1974 and was used for storage and served as an enclosure for a substation. The building has two sections; a metal enclosure containing high-voltage switches and a

transformer; and a concrete building containing a battery bank and associated supplies. A 1986 underground storage tank (UST) Registration document reports the presence of a 20,000-gallon fuel oil tank.

Previous Investigations

A summary of investigative activities is presented in Table 4.8.8, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report.*

Table 4.8.8
Summary of AOC 531 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 – 1996	Site investigation of soil.	
	1995	***Round 1*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (531SB001-530SB003): metals, SVOCs, VOCs, and PCBs	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (531SB004, 531SB005): metals, SVOCs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Five sample locations associated with AOC 531 were evaluated for the presence of contaminants between 1995 and 1996. All five locations are within the boundaries of Drainage Basin 23. Surface and subsurface soil samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the substation, UST, and previous activities at the site. Of particular interest were detections of BEQs in soil. Surface soil was recommended for CMS.

4.8.1.8 AOC 538 and AOC 539

Site Description and History

AOC 538 and AOC 539 were combined into one investigative unit because of their close proximity. It is bounded by Second Street to the north, Building 3 to the south, Hobson Avenue to the west, and an open paved area to the east. AOC 538, an old forge shop constructed in 1906, is located in the eastern portion of Building 6. This site consisted of various metal working processes. The most recent forge furnaces were oil-fired and numerous quench oil tanks were present in the shop. AOC 539, propeller shop, is located in the western extension of Building 6, which was added in 1967. The Zyglo process was used here until it was replaced by the red dye process in 1979. Zyglo reportedly was rinsed from the propellers onto the floor and then washed outside into the storm sewer and the red dye process excess waste was collected in a portable AST.

Previous Investigations

A summary of investigative activities is presented in Table 4.8.9, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.8.9
Summary of AOC 538 and 539 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 – 1996	Site investigation of soil.	
	1995	***Round 1*** **AOC 538** **Soil:** 8 surface borings (0 to 1 foot) (538SB001, 538SB004 – 538SB010): metals, SVOCs, VOCs 6 subsurface borings (3 to 5 feet) (538SB001, 538SB004 -538SB008): metals, SVOCs, VOCs	***Round 1*** **AOC 538** **Groundwater:** No Groundwater Samples Collected.
		AOC 539 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (539SB001 – 539SB003): metals,	**AOC 539** No Groundwater Samples Collected.

Table 4.8.9
Summary of AOC 538 and 539 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		SVOCs, VOCs	
RFI (EnSafe)	1996	***Round 2*** **AOC 538** **Soil:** No Soil Samples Collected.	***Round 2*** **AOC 538** **Groundwater:** 1 shallow well (538001): VOCs, SVOCs, metals and general chemistry
		AOC 539 No Soil Samples Collected.	**AOC 539** (539001): VOCs, SVOCs, metals and general chemistry
RFI (EnSafe)	1996	***Round 3*** **AOC 538** **Soil:** No Soil Samples Collected.	***Round 3*** **AOC 538** **Groundwater:** 1 shallow well (538001): VOCs, SVOCs, metals and general chemistry
		AOC 539 No Soil Samples Collected.	**AOC 539** (539001): VOCs, metals and general chemistry
RFI (EnSafe)	1996	***Round 4*** **AOC 538** **Soil:** No Soil Samples Collected.	***Round 4*** **AOC 538** **Groundwater:** 1 shallow well (538001): VOCs, SVOCs, metals and general chemistry
		AOC 539 No Soil Samples Collected.	**AOC 539** (539001): VOCs, metals and general chemistry
RFI Addendum Work Plan (EnSafe)	1997	***Round 5*** **AOC 538** **Soil:** No Soil Samples Collected.	***Round 5*** **AOC 538** **Groundwater:** 1 shallow well (538001): VOCs, SVOCs, metals and general chemistry
		AOC 539 No Soil Samples Collected.	**AOC 539** (539001): VOCs, metals and general chemistry
RFI Addendum Work Plan (EnSafe)	1998	***Round 6*** **AOC 538** **Soil:** No Soil Samples Collected.	***Round 6*** **AOC 538** **Groundwater:** 1 shallow well (538001): VOCs
		AOC 539 No Soil Samples Collected.	**AOC 539** (539001): VOCs

Nature and Extent of Contaminants

Thirteen sample locations associated with AOC 538 and AOC 539 were evaluated for the presence of contaminants between 1995 and 1998. All 13 locations are within the boundaries of Drainage Basin 23. Surface, subsurface, and groundwater were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the forge shop and previous activities at the site. Of particular interest were detections of BEQs in soil, arsenic and thallium in groundwater. Surface soil, shallow groundwater, and deep groundwater were recommended for CMS.

4.8.1.9 AOC 550

Site Description and History

AOC 550 was located on the eastern corner of the Roe Avenue/Machinist Street intersection, approximately 37 feet south of Building 62, adjacent to Pier Charlie. The site is bound by Building 62 to the north, Pier Charlie to the south, and open paved areas to the east and west. This area is associated with former Building 1111, a transportable boiler house used by the U.S. Marine Corp from 1927 to 1941. The dimensions of the facility are unknown and due to the mobile nature of the boiler house, historical base maps reference two separate locations for this facility. The second location was on the eastern side of the intersection of Second Street and Roe Avenue, between Building 342 and Building 62.

Previous Investigations

A summary of investigative activities is presented in Table 4.8.10, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.8.10
Summary of AOC 550 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1997	Site investigation of soil and groundwater	
	1996	***Round 1*** **Soil**: 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (550SB001, 550SB007 - 550SB008): metals, SVOCs, VOCs (550SB002 and 550SB006): SVOCs, and metals (1duplicate collected for the same parameters)	***Round 1*** **Groundwater**: No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (550001): VOCs, SVOCs, metals, and general chemistry
RFI (EnSafe)	1996	***Round 3*** **Soil**: 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (550SB009 and 550SB010): metals, SVOCs	***Round 3*** **Groundwater:** 1 shallow well (550001): metals, and general chemistry
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (550001): metals, and general chemistry
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (550001): metals, and general chemistry
MNA (EnSafe)	1998	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 1 shallow well (550001): VOCs
MNA (EnSafe)	1998	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 1 shallow well (550001): VOCs

Nature and Extent of Contaminants

Eight sample locations associated with AOC 550 were evaluated for the presence of contaminants between 1993 and 1998. Of these eight, one location is within the boundaries of

Drainage Basin 23. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the transportable boiler house and previous activities at the site. Of particular interest were detections of BEQs in soil; and arsenic and thallium in groundwater. Subsurface soil and shallow groundwater were recommended for CMS.

4.8.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 23/2 on September 25, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 23 into the Cooper River. Analytical detections for sample EFF016 are presented in Table 4.8.11.

Table 4.8.11
Storm Water Effluent Sampling Results
Drainage Basin 23

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
23	23/2	EFF016	Aluminum	170	3,277	NL	No
			Antimony	**6.60**	**5.93**	**NL**	**Yes**
			Barium	21	60.31	NL	No
			Calcium*	30,000	53,455	NL	No
			Chromium	1.10	13	50	No
			Iron	490	4,134	NL	No
			Magnesium*	41,000	49,255	NL	No
			Manganese	49	74.52	NL	No
			Nickel	3.40	5.14	8.30	No
			Potassium*	20,000	23,678	NL	No
			Sodium*	380,000	395,333	NL	No
			Thallium	6.80	5.77	21.3	No
			Vanadium	3.40	15.59	NL	No
			Zinc	300	307.83	86	No
			1,4-Dichlorobenzene	0.31	NL	19.9	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.8.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 23. Table 4.8.12 summarizes the migration pathway scenarios.

Table 4.8.12
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 23

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.8.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS for Building 2, in June 1987, Shop 11 was instructed to stop flushing hydraulic acid to the storm drain. Follow-up action was taken to prevent further incidents. The EBS for Facility 226 stated that spills of various substances associated with the plating operations occurred and that some of the materials reached the storm water sewer system. Materials that were identified in the spills were chromic acid, cadmium, and metal hydroxide sludge. The EBS for Facility 5 states that in August 1989 an unspecified quantity of oil spilled from a valve and flowed into a nearby storm drain located on the northeast side of the building. The spill reportedly was cleaned up.

Though past practices may make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF016 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.8.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that nine of 95 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone E background concentrations and the ecological risk based screening criteria identified four sample location areas (Figure 4-8A) which have the potential to provide an upland source of antimony in the storm sewer system. A summary of this evaluation is provided in Table 4.8.13.

Table 4.8.13
Drainage Basin 23
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Value (mg/kg)	Distance (ft) to Catch Basin
23/5-A	023SB004*	Antimony	7.00	1.73 (BKG)	65
23/7/1	541SB001*	Antimony	29.5	1.73 (BKG)	35
23/7/1-B	542SB004*	Antimony	3.80	1.73 (BKG)	75
	542SB007*	Antimony	27.4	1.73 (BKG)	35

Notes:
* = Sample location is located under pavement and constituents from these locations most likely do not represent complete exposure pathways to the storm water system

Evaluation of surface soil data to determine possible upland terrestrial source identification with EFF016 COPCs revealed that antimony was detected in surface soil above screening criteria at locations under pavement between 35 and 75 feet of several catch basins (23/5-A, 23/7/1, and 23/7/1-B). Therefore, the pathway is complete for antimony.

4.8.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative

approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 23 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with antimony intercepting the storm water drainage pipeline within Drainage Basin 23.

4.8.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study, the *Zone L RFI Report,* and *Process Closure for SWMU 37 Dye Test Cross-connect Resolution in Buildings 3, 9, and 68* Completion Report (Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP) Nov, 1998) indicates that there were cross-connects present from Building 3 in Drainage Basin 23 which were subsequently eliminated prior to publication of the Completion Report. No other cross-connects were reported from the Zone L dye test program.

4.8.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 23 due to a lack of an upland terrestrial source identification.

4.9 Drainage Basin 26

Drainage Basin 26 encompasses approximately 2 acres within Zone E in the central section of the CNC. Land cover within the basin consists of approximately 80% paved surfaces and 20% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the 11 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 26.

Figure 4-9 illustrates the area encompassing Drainage Basin 26 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.9.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are two SWMUs/AOCs that are partially or completely within the boundary of Drainage Basin 26. The sites are listed in Table 4.9.1 with the current status of each site. AOC 550 (Boiler House) was included in the Zone J data evaluation. The majority of SWMU 65 is located in Drainage Basin 23; however, two sample points associated with this site fall within the boundaries of Drainage Basin 26. The evaluation of SWMU 65, as it relates to Drainage Basin 26, will be limited to these two sample locations.

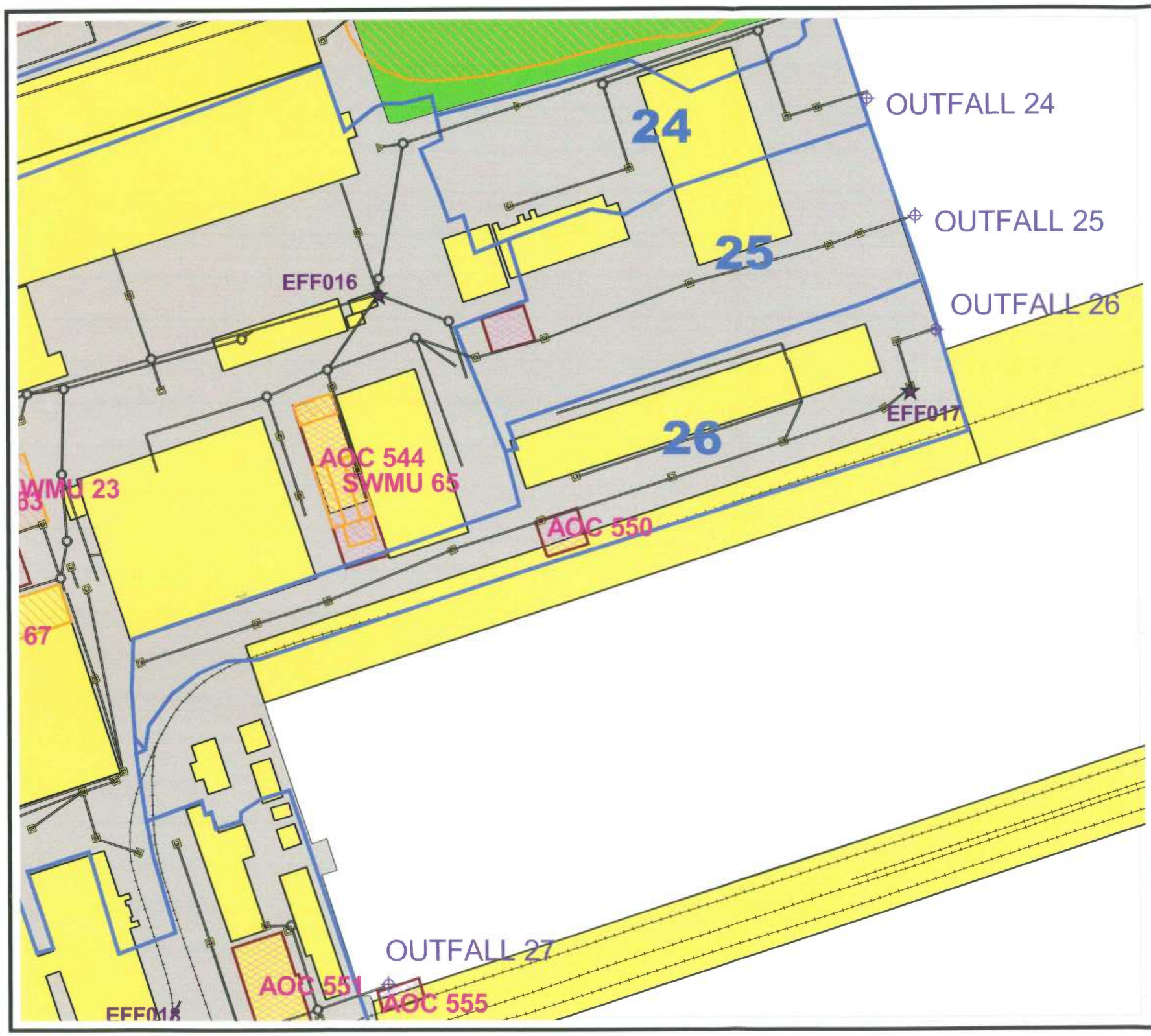
Table 4.9.1
Drainage Basin 26 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 65	Lead Storage Area	Draft RFI Report; RFI Sampling and Analysis Plan
AOC 550	Boiler House	Draft RFI Report; RFI Report Addendum

4.9.1.1 SWMU 65

Site Description and History

SWMU 65 consists of a former lead storage area in which lead blankets and shielding materials were stored on pallets and shelves inside and on a paved area south of Building 221. SWMU 65 and AOCs 544 and 546 were combined into one investigative unit because of their close proximity. SWMU 65 is associated with Building 221 and is bound to the north by Second Street, Building 74 to the east, Pier C to the south, and Building 56 to the west. The majority of



N

100 0 100 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-9
Drainage Basin 26

November 2002 | Zone J Main Project.apr

lead was encased in rubber but some exposed lead was stored beneath tarps inside the building. This site was also used as a staging area for scrap lead awaiting disposal.

Previous Investigations

For SWMU 65, the RFI is the only investigation that has been conducted for this site. A summary of investigative activities is presented in Table 4.9.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.9.2
Summary of SWMU 65 Investigation
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1997	Site investigation of soil and groundwater	
		Round 1 **Soil**: 6 surface borings (0 to 1 foot) (2 duplicates) 4 subsurface borings (3 to 5 feet) (2 duplicates) borings (065SB001 - 065SB006) (065SB001, 065SB003, 065SB005, 065SB006): metals, SVOCs, VOCs, pesticides/PCBs, cyanide. * 1 subsurface boring (11.5 to 13.5 feet) (065SB00603) and one free product sample (065SBFP602) were collected at 065SB006 after free product was noted during drilling.	***Round 1*** **Groundwater**: 8 shallow wells (065001 - 065008): metals, SVOCs, VOCs, pesticides/PCBs, cyanide.
RFI (EnSafe)	1996 - 1997	***Round 2*** **Soil**: 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (065SB007 and 065SB008): metals, SVOCs	***Round 2*** **Groundwater:** 8 shallow wells (065001 - 065008): metals, SVOCs, VOCs, pesticides/PCBs, cyanide
RFI (EnSafe)	1996 - 1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 8 shallow wells (065001 - 065008): metals, SVOCs, VOCs, pesticides/PCBs, cyanide

Table 4.9.2
Summary of SWMU 65 Investigation
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 8 shallow wells (065001 - 065008): metals, SVOCs, VOCs, pesticides/PCBs, cyanide

Nature and Extent of Contaminants

Twenty-three sample locations associated with SWMU 65 were evaluated for the presence of contaminants in 1996 and 1997. Of the 23 locations, only two are within the boundaries of Drainage Basin 26. Surface, subsurface, groundwater, and wipe samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the storage and staging of lead blankets and shielding materials and scrap lead associated with previous activities at the site. Of particular interest were detections of aldrin, dieldrin, arsenic, and BEQs in soil, and antimony, arsenic, beryllium, cadmium, chromium, lead, mercury, thallium, trichloroethene, and vinyl chloride in groundwater. Surface and subsurface soil and shallow and deep groundwater were recommended for CMS.

4.9.1.2 AOC 550

Site Description and History

AOC 550 was located on the eastern corner of the Roe Avenue/Machinist Street intersection, approximately 37 feet south of Building 62, adjacent to Pier Charlie. This area is associated with former Building 1111, a transportable boiler house used by the U.S. Marine Corp from 1927 to 1941. The dimensions of the facility are unknown and due to the mobile nature of the boiler house, historical base maps reference two separate locations for this facility. The second location was on the eastern side of the intersection of Second Street and Roe Avenue, between Building 342 and Building 62.

Previous Investigations

For AOC 550, the RFI is the only investigation that has been conducted for this site. A summary of investigative activities is presented in Table 4.9.3, which contains the date of the activities,

number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.9.3
Summary of AOC 550 Investigation
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1997	Site investigation of soil and groundwater	
		Round 1 **Soil**: 5 surface borings (1duplicate) (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (550SB001 and 550SB002 and 550SB006-550SB008): metals, SVOCs, VOCs	***Round 1*** **Groundwater**: 1 shallow well (550001): chlorides, metals, sulfates, TDS, SVOCs, VOCs
RFI (EnSafe)	1996 - 1997	***Round 2*** **Soil**: 2 surface borings (0 to 1 foot) 2 subsurface soil borings (3 to 5 feet) (550SB009 and 550SB010): metals, SVOCs	***Round 2*** **Groundwater:** 1 shallow well (550001): chlorides, metals, sulfates, TDS, SVOCs, VOCs
		Round 3 No Soil Samples Collected.	***Round 3*** **Groundwater:** 1 shallow well (550001): Chlorides, metals, Sulfates, TDS, SVOCs, VOCs
		Round 4 No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (550001): Chlorides, metals, Sulfates, TDS, SVOCs, VOCs
MNA (EnSafe)	1998	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 1 shallow well (550001): VOCs
MNA (EnSafe)	1998	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (550001): VOCs

Nature and Extent of Contaminants

Seven sample locations associated with AOC 550 were evaluated for the presence of contaminants between 1996 and 1998. All seven locations are within the boundaries of Drainage Basin 26. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the transportable boiler house and previous activities at the site. Of particular interest were detections of BEQs in soil; and arsenic and thallium in groundwater. Subsurface soil and shallow groundwater were recommended for CMS.

4.9.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 26-B on June 18, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 26 into the Cooper River. Analytical detections for sample EFF017 are presented in Table 4.9.4.

Table 4.9.4
Storm Water Effluent Sampling Results
Drainage Basin 26

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L): Reference Concentration	Screening Value (μg/L): Chronic Saltwater Screening Value	Potential COPC
26	26-B	EFF017	Aluminum	540	3,277	NL	No
			Barium	7.50	60.31	NL	No
			Calcium*	3,700	53,455	NL	No
			Chromium	4.90	13	50	No
			Cobalt	0.94	2.00	NL	No
			Copper	30	41.98	2.90	No
			Iron	1,100	4,134	NL	No
			Lead	16	33.63	8.50	No
			Magnesium*	3,000	49,255	NL	No
			Manganese	28	74.52	NL	No
			Nickel	2.90	5.14	8.30	No
			Potassium*	1,700	23,678	NL	No
			Sodium*	26,000	395,333	NL	No
			Vanadium	3.30	15.59	NL	No
			Zinc	**480**	**307.83**	**86**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.9.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 26. Table 4.9.5 summarizes the migration pathway scenarios.

Table 4.9.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 26

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.9.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS for Facility 62, Environmental Incident Report #86-146 reported that on December 9, 1986 approximately 1,000 gallons of oil were spilled into the storm catch basin on the south side of building 62 with approximately 20 gallons entering the Cooper River. The EBS for Facility 333, Pier C, states that numerous relatively small spills, less than ten gallons, of such materials as lube oil, fuel oil, acids, caustics and paints are reported to have occurred at this facility.

Though past incidents may make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF017 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.9.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that six of 11 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone E background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source of zinc in the storm sewer system.

4.9.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 26 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with zinc intercepting the storm water drainage pipeline within Drainage Basin 26.

4.9.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 26.

4.9.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 26 due to a lack of an upland terrestrial source identification.

4.10 Drainage Basin 27

Drainage Basin 27 encompasses approximately 8.5 acres within Zone E in the central section of the CNC. Land cover within the basin consists of approximately 50% paved surfaces and 50% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the 55 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 27.

Figure 4-10 illustrates the area encompassing Drainage Basin 27 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.10.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there is one SWMU and four AOCs within the boundary of Drainage Basin 27. The sites are listed in Table 4.10.1 with the current status of each site. The drainage basin includes SWMU 25 (Old Plating Operation), AOC 549 (Former Scrap Yard), AOC 551 (Boiler House), AOC 552 (Former Galvanizing Shop), and AOC 559 (Central Power Station). Only a small portion of AOC 559 (northwest corner) is located within Drainage Basin 27.

Table 4.10.1
Drainage Basin 27 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 25	Old Plating Operation	RFI Completed; Phase I and II CMS Work Plan
AOC 549	Former Scrap Yard	Draft RFI Report
AOC 551	Boiler House	Draft RFI Report
AOC 552	Former Galvanizing Shop	Draft RFI Report
AOC 559	Central Power Station	Draft RFI Report; RFI Report Addendum; CMS Work Plan; NFA Pending

4.10.1.1 SWMU 25

Site Description and History

SWMU 25 is located in the northwest portion of Zone E and is bounded by Building 5 to the north, Building 57 to the south, Hobson Avenue to the west, and Avenue "B" to the east. SWMU 25 consisted of a former electroplating operation associated with Building 44 with

N

200 0 200 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-10
Drainage Basin 27

November 2002 | Zone J Main Project.apr

approximately 40 metal tanks that contained solutions used in plating processes until operations ceased in 1983. The process tanks and associated equipment were removed in 1995 during closure operations of Charleston Naval Shipyard. SWMU 25 has been the subject of three IM activities conducted by the Navy Environmental Detachment in 1997, 1998, and 1999. Building 44 was demolished between February and April 1997, generating approximately 330 tons of contaminated building material. The material was transported to the Laidlaw Environmental Services landfill in Pinewood, South Carolina for disposal. Between June and August 1998, 3.1 tons of chromium contaminated fluid was removed from the electrical vault beneath Building 44. This waste was transported to Chem-Met Services for disposal. The final IM consisted of the removal of the electrical vault and associated cables. The excavation was conducted in July 1999 generating approximately 25 tons of chromium contaminated debris. The debris was transported to the Safety Kleen Inc. landfill in Pinewood, South Carolina.

Previous Investigations

In addition to the RFI, SWMU 25 has been the subject of previous assessments in conjunction with RCRA closure activities and preliminary RFI activities conducted in the fall of 1993. A summary of investigative activities is presented in Table 4.10.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone E RFI Report*.

Table 4.10.2
Summary of SWMU 25 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Preliminary RFI	1993	Site Investigation of soil and groundwater.	
		Soil: 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (025SB001 – 025SB003): metals, SVOCs, VOCs.	**Groundwater**: 3 shallow wells (025001 – 025003): metals, SVOCs, VOCs.
RFI (EnSafe)	1995 - 1997	Site investigation of soil and groundwater	

Table 4.10.2
Summary of SWMU 25 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		Round 1 **Soil**: 10 surface borings (0 to 1 foot) (025SB004 - 025SB013): metals, SVOCs, VOCs, pesticides/PCBs, cyanide. (2 duplicates) 9 subsurface borings (3 to 5 feet) (025SB004 – 025SB006, 025SB008 – 025SB013): metals, SVOCs, VOCs, pesticides/PCBs, cyanide. (1 duplicate) **Sediment**: 1 sediment sample (025M0001): metals, SVOCs, VOCs, pesticides/PCBs, cyanide.	***Round 1*** **Groundwater:** 4 shallow wells (025001 – 025004): metals, SVOCs, VOCs, pesticides/PCBs, cyanide.
RFI (EnSafe)	1995 - 1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 4 shallow wells (025001 – 025004): metals, SVOCs, VOCs, pesticides/PCBs, cyanide
RFI (EnSafe)	1995 - 1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 4 shallow wells (025001 – 025004): metals, SVOCs, VOCs, pesticides/PCBs, cyanide
RFI (EnSafe)	1995 - 1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 4 shallow wells (025001 – 025004): metals, SVOCs, VOCs, pesticides/PCBs, cyanide
IM (Navy Detachment)	1997 - 1998	**Soil**: 14 surface borings (0 to 1 foot) 14 subsurface borings (3 to 5 feet) (025SB014 – 025SB027): metals, SVOCs	**Groundwater:** No Groundwater Samples Collected.
CH2M-Jones	2001	**Soil:** No Soil Samples Collected.	**Groundwater:** 4 shallow wells (025GW001L - 025GW004L): Dissolved metals, hexavalent chromium, VOCs

Nature and Extent of Contaminants

Forty-nine sample locations associated with SWMU 25 were evaluated for the presence of contaminants in 1996 through 1998. Of the 49 locations, 37 are within the boundaries of

Drainage Basin 27. Surface, subsurface, groundwater, sediment, and wipe samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to plating operations associated with previous activities at the site. Of particular interest were detections of arsenic, cadmium, chromium, lead, dieldrin, tetrachloroethene, and BEQs in soil; antimony, cadmium, chromium, lead, nickel, thallium, trichloroethene, tetrachloroethane, alpha and gamma chlordane in groundwater. Surface and subsurface soil, sediment, and shallow groundwater were recommended for CMS.

4.10.1.2 AOC 549

Site Description and History

AOC 549 was combined into one investigative unit with SWMU 70 and AOC 548 because of their close proximity. The site was located in an area that included the northern edge of Building 5 and the southwestern edge of Building 3, including the alley between the two buildings. It is bound by Building 3 to the north, Building 5 to the south, Hobson Avenue to the west, and Third Street to the east. AOC 549 consists of a former scrap yard north of Building 5 (1920s and 1930s) and is currently paved with concrete and asphalt.

Previous Investigations

For AOC 549, the RFI is the only investigation that has been conducted for this site. A summary of investigative activities is presented in Table 4.10.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone E RFI Report*.

Table 4.10.3
Summary of AOC 549 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1997	Site investigation of soil and groundwater	
		Round 1 **Soil**: 10 surface borings (0 to 1 foot) (549SB001 – 549SB010)	***Round 1*** **Groundwater**: 3 shallow wells (549001 - 549003)

Table 4.10.3
Summary of AOC 549 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		9 subsurface borings (3 to 5 feet) (549SB001- 549SB004 and 549SB006 - 549SB010): metals, SVOCs, VOCs, pesticides/PCBs, cyanide.	metals, SVOCs, VOCs, pesticides/PCBs, cyanide.
RFI (EnSafe)	1996 - 1997	***Round 2*** **Soil**: 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (549SB011 - 549SB014): metals, SVOCs	***Round 2*** **Groundwater:** 3 shallow wells (549001-549003) metals, SVOCs, VOCs, pesticides/PCBs, cyanide
RFI (EnSafe)	1996 - 1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater**: 3 shallow wells (549001-549003) metals, SVOCs, VOCs, pesticides/PCBs, cyanide
RFI (EnSafe)	1996 - 1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 3 shallow wells (549001-549003) metals, SVOCs, VOCs, pesticides/PCBs, cyanide
RFI Addendum (EnSafe)	1998	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (549003) in 1999 included filtered and unfiltered samples for: metals, SVOCs, VOCs, pesticides/PCBs, cyanide
RFI Addendum (EnSafe)	2000	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 3 shallow wells (549001-549003): hexavalent chromium
CH2M-Jones	2001	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 3 shallow wells (549001L-549003L): Dissolved metals, hexavalent chromium. (549002L and 549003L) Dissolved metals, hexavalent chromium, VOCs

Nature and Extent of Contaminants

Seventeen sample locations associated with AOC 549 were evaluated for the presence of contaminants between 1996 and 2000. Of these 17, approximately 10 locations are within the boundaries of Drainage Basin 27. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the former scrap yard and previous activities at the site. Of particular interest were detections of copper, lead, and BEQs in soil; and antimony, cadmium, chromium, thallium, trichloroethene, and vinyl chloride in groundwater. Surface soil and shallow groundwater were recommended for CMS.

4.10.1.3 AOC 559

Site Description and History

AOC 559 was combined into one investigative unit with AOC 560 and AOC 561 because of their close proximity. AOC 559 is the Central Power Station (Building 32) located at the intersection of Hobson Avenue and McMillan Avenue, adjacent to the McMillan gate entrance. It is bound by McMillan Avenue to the north, Building 451-B to the south, Carolina Avenue to the west, and Hobson Avenue to the east. The site is a three-story brick and concrete structure constructed in 1909 that had historically burned coal, fuel oil, and diesel fuel for steam and electric generation.

Previous Investigations

The RFI is the only investigation that has been conducted at AOC 559. A summary of investigative activities is presented in Table 4.10.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report.*

Table 4.10.4
Summary of AOC 559 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
RFI (EnSafe)	1995 - 1997	Site investigation of soil and groundwater

Table 4.10.4
Summary of AOC 559 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		Round 1 **Soil**: 22 surface borings (0 to 1 foot) (559SB001 – 559SB022) (3 duplicates) 21 subsurface borings (3 to 5 feet) (559SB001 – 559SB004, 559SB006, 559SB022): metals, SVOCs, VOCs, pesticides/PCBs, cyanide.	***Round 1*** **Groundwater**: 5 shallow wells (559001 – 559005): metals, SVOCs, VOCs.
RFI (EnSafe)	1995 - 1997	***Round 2*** **Soil**: 6 surface borings (0 to 1 foot) (2 duplicates) 6 subsurface borings (3 to 5 feet) (559SB023 – 559SB025, 559SB027 – 559SB029): metals, SVOCs, VOCs, pesticides/PCBs, cyanide.	***Round 2*** **Groundwater:** 5 shallow wells (559001 – 559005): metals, SVOCs, VOCs.
RFI (EnSafe)	1995 - 1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 5 shallow wells (559001 – 559005): metals, SVOCs, VOCs.
RFI (EnSafe)	1995 - 1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 5 shallow wells (559001 – 559005): metals, SVOCs, VOCs.

Nature and Extent of Contaminants

Thirty-six sample locations associated with AOCs 559 were evaluated for the presence of contaminants between 1996 and 1997. Of these 36, there are no locations within the boundaries of Drainage Basin 27. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the power station and previous activities at the site. Of particular interest were detections of arsenic, beryllium, PCBs, and BEQs in soil; benzene, chlorobenzene, 1,2-dichlorobenzene, and 1,4-dichlorobenzene in shallow groundwater; and trichloroethene and thallium in deep groundwater. Surface and subsurface soil and shallow and deep groundwater were recommended for CMS.

4.10.1.4 AOC 551 and AOC 552
Site Description and History

AOC 551 was combined into one investigative unit with AOC 552 because of their close proximity. AOC 551 was a boiler house that was located in Building 1119 and has undergone renovations since being used as a boiler house before 1942. AOC 552 was used as a galvanizing shop and tooling shop located in Building 1030, which no longer exist. The sites are located at the intersection of Avenue "A" and McMillan Avenue, adjacent to Pier Delta, and are bound by Building 46 to the north, Dry Dock No.1 to the south, Building 43 to the west, and Pier Delta to the east. Both sites are currently paved with concrete and asphalt, traversed by a pair of nuclear-grade railroad tracks.

Previous Investigations

For AOCs 551 and 552, the RFI is the only investigation that has been conducted for this site. A summary of investigative activities is presented in Table 4.10.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.10.5
Summary of AOC 551 and AOC 552 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 - 1997	Site investigation of soil and groundwater	
		Round 1 **Soil**: 9 surface borings (0 to 1 foot) (2 duplicates) 9 subsurface borings (3 to 5 foot) (551SB001 – 551SB006 and 552SB001, 552SB002, 552SB004): metals, SVOCs, VOCs, pH.	***Round 1*** **Groundwater**: 2 shallow wells (551001, 551002): metals, SVOCs, VOCs.
RFI (EnSafe)	1995 - 1997	***Round 2*** **Soil**: 1 surface borings (0 to 1 foot) (551SB007): metals, SVOCs, VOCs, pH.	***Round 2*** **Groundwater:** 2 shallow wells (551001, 551002): metals, SVOCs, VOCs.
RFI (EnSafe)	1995 - 1997	***Round 3***	***Round 3***

Table 4.10.5
Summary of AOC 551 and AOC 552 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		Soil: No Soil Samples Collected.	**Groundwater:** 2 shallow wells (551001, 551002): metals, SVOCs, VOCs.
RFI (EnSafe)	1995 - 1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (551001, 551002): metals, SVOCs, VOCs.

Nature and Extent of Contaminants

Thirteen sample locations associated with AOCs 551 and 552 were evaluated for the presence of contaminants from 1995 to 1997. All 13 locations are within the boundaries of Drainage Basin 27. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the former boiler house and galvanizing shop, and previous activities at the site. Of particular interest were detections of lead and BEQs in soil; and thallium in groundwater. Surface soil and shallow groundwater were recommended for CMS.

4.10.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 27/A-1 on June 18, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 27 into the Cooper River. Analytical detections for sample EFF018 are presented in Table 4.10.6.

Table 4.10.6
Storm Water Effluent Sampling Results
Drainage Basin 27

					Screening Value (μg/L)		
Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Reference Concentration	Chronic Saltwater Screening Value	Potential COPC
27	27/A-1	EFF018	Aluminum	180	3,277	NL	No
			Barium	8.80	60.31	NL	No
			Calcium*	8,500	53,455	NL	No

Table 4.10.6
Storm Water Effluent Sampling Results
Drainage Basin 27

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
			Chromium	1.80	13	50	No
			Copper	**63**	**41.98**	**2.90**	**Yes**
			Iron	300	4,134	NL	No
			Lead	11	33.63	8.50	No
			Magnesium*	17,000	49,255	NL	No
			Manganese	13	74.52	NL	No
			Nickel	3.10	5.14	8.30	No
			Potassium*	6,200	23,678	NL	No
			Sodium*	140,000	395,333	NL	No
			Vanadium	7.00	15.59	NL	No
			Zinc	240	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.10.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 27. Table 4.10.7summarizes the migration pathway scenarios.

Table 4.10.7
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 27

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system →Zone J	No

4.10.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS for Facility 44, the old machine and plating shop, an Initial Assessment Report conducted in 1981, stated that prior to 1972 untreated rinse water was discharged to the Cooper River via the combined sewer system. The rinse water was generated when rinsing baths used to clean metal surfaces before and after electroplating became contaminated with fugitive metals requiring disposal. After 1972, the plating wastes were neutralized and disposed of in the storm drain. A 1990 Environmental Incident Report stated chromium levels in Manhole 7A were greater than 3000 parts per million when the manhole was sampled because of an orange substance in the manhole.

Though past practices may make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF018 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.10.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 55 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone E background concentrations and the ecological risk based screening criteria identified several sample location areas which have COPCs consistent to those identified in EFF018. Table 4.10.8 lists the locations that have background exceedances for cooper.

Table 4.10.8
Drainage Basin 27
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPC	Concentration (mg/kg)	Screening Value (mg/kg)	Distance (ft) to Catch Basin
27/4/4-B	*025SB023	Copper	494	120 (BKG)	13.9
	*025SB027	Copper	172	120 (BKG)	17.2
	*025SB022	Copper	210	120 (BKG)	42.0
	*025SB020	Copper	150	120 (BKG)	45.6
	*025SB009	Copper	539	120 (BKG)	73.9
27/1-A	551SB006	Copper	292	120 (BKG)	51.6
27/4/5	*549SB012	Copper	1,320	120 (BKG)	12.8
	*549SB001	Copper	1,900	120 (BKG)	27.0
	*549SB011	Copper	145	120 (BKG)	29.2
	*549SB010	Copper	255	120 (BKG)	33.4
	*549SB008	Copper	324	120 (BKG)	65.2

Notes:
* = Sample location is located under pavement and constituents from these locations most likely do not represent complete exposure pathways to the storm water system.

Evaluation of surface soil data to determine possible upland terrestrial source identification with the EFF018 COPC revealed that copper was detected in surface soil above screening criteria at locations from approximately 13 to 74 feet of catch basins within Drainage Basin 27. The soil samples collected during the investigation of SWMU 25 were most likely removed during the building demolition and subsequent removal of soil and the vault at this SWMU. Soils associated with AOC 549 were all collected in areas that are currently (and have historically been) covered with pavement. As a result, it is unlikely that the constituents in these soil sample locations could travel via sheet flow from their locations to the storm water system. Sample 551SB006 contains levels of copper elevated above the background concentration. However, sample 551SB007 is between catch basin 27/1-A and sample 551SB006 which does not contain copper at concentrations that exceed the background value. Therefore, this pathway is incomplete for copper at Drainage Basin 27.

4.10.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were

identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 27 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with copper intercepting the storm water drainage pipeline within Drainage Basin 27.

4.10.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study, the *Zone L RFI Report,* and *Process Closure for SWMU 37 Dye Test Cross-connect Resolution in Buildings 3, 9, and 68* Completion Report (Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP) Nov, 1998) indicates that there were cross-connects present from Building 1119 in Drainage Basin 27 which were not eliminated prior to publication of the Completion Report. Building 1119 is down gradient of the DB27 storm water effluent sample location. No other cross-connects were reported from the Zone L dye test program.

4.10.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 27 due to a lack of upland terrestrial source identification.

4.11 Drainage Basin 28

Drainage Basin 28 encompasses approximately 79 acres within Zones C and E in the central section of the CNC. Land cover within the basin consists of approximately 80% paved surfaces and 20% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the 193 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 28.

Figure 4-11 illustrates the area encompassing Drainage Basin 28 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.11.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are two SWMUs and four AOCs within the boundary of Drainage Basin 28. The sites are listed in Table 4.11.1 with the current status of each site. The source areas include AOC 520 (Former Garbage House), AOC 522 (Former Grease and Wash Building), AOC 523 (Former Gas Station), and AOC 559 (Central Power Station), SWMU 170 (Dry Dock No. 1 - PCB Removal Area), SWMU 171 (Dry Dock No. 2 PCB Removal Area). Most of SWMU 170, SWMU 171, and AOC 559 are located in Drainage Basin 30. However, four sample points located on the western boundary of SWMU 170 extend into Drainage Basin 28; therefore the evaluation of SWMU 170 will be limited to these four sample locations. Five sample locations associated with the western boundary of SWMU 171 area fall within the boundaries of Drainage Basin 28 and the evaluation of SWMU 171 will be limited to these 5 sample locations. The north/northeast boundary of AOC 559 extends into Drainage Basin 28 where 12 sample points associated with this AOC fall within the boundaries of Drainage Basin 28. The evaluation of AOC 559 will be limited to these 12 sample locations.

Table 4.11.1
Drainage Basin 28 AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 170	Dry Dock No. 1 PCB Removal Area	Draft RFI Report; RFI Addendum Report; NFA
SWMU 171	Dry Dock No. 2 PCB Removal Area	Draft RFI Report; RFI Addendum Report; NFA
AOC 520	Former Garbage House	Conditional Approval of Revised 1998 RFI Report

N

200 0 200 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-11
Drainage Basin 28

November 2002 | Zone J Main Project.apr

Table 4.11.1
Drainage Basin 28 AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 522	Former Grease and Wash Building	Conditional Approval of 1998 RFI Report
AOC 523	Former Gas Station	RFI Addendum Report; CMS Work Plan
AOC 559	Central Power Station	RFI Report Addendum; CMS Work Plan; CMS Study Report; NFA
AOC 570	Former Coal Storage Area	Drat RFI Report; Sampling and Analysis Plan

4.11.1.1 SWMU 170 and SWMU 171
Site Description and History

SWMU 170 and SWMU 171 were combined into one investigative unit because of their close proximity. The sites are located in an area bound by McMillan Avenue to the north, Fourth Street to the south, Hobson Avenue to the west, and Dry Dock No. 1 and No. 2 to the east. SWMU 170 and SWMU 171 consist of storage areas immediately west of Dry Dock No. 1 and No. 2, respectively. Missile launching tubes removed from decommissioned ballistic missile submarines were stored in these areas to dismantle and removal of PCB-containing components (1980s – 1990s). The missile tube dismantling areas had no secondary containment.

Previous Investigations

A summary of investigative activities is presented in Table 4.11.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Zone E RFI Report*.

Table 4.11.2
Summary of SWMU 170 and SWMU 171 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 - 1997	Site investigation of soil, sediment, and asphalt core samples. **Soil**: **SWMU 170**: 15 surface borings (0 to 1 foot) 2 duplicates (170SB001 - 170SB015): PCBs	**Asphalt core samples**: **SWMU 170**: 15 asphalt samples (170KB001 - 170KB017): PCBs **SWMU 171**: 17 asphalt samples (171KB001,

Table 4.11.2
Summary of SWMU 170 and SWMU 171 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		(170SB011, 170SB013, 170SB014, 170SB015): PCBs and VOCs. 10 subsurface borings (3 to 5 feet) (170SB001, 170SB003, 170SB006 - 170SB009, 170SB011 – 170SB014): PCBs **SWMU 171**: 20 surface borings (0 to 1 foot) 2 duplicates (171SB002, 171SB003, 171SB005 - 171SB016, 171SB019 – 171SB023, 171SB025) 17 subsurface borings (3 to 5 feet) three duplicates (171SB002, 171SB003, 171SB005 – 171SB008, 171SB010 - 171SB012, 171SB014 – 171SB016, 171SB019, 171SB020, 171SB022, 171SB023, 171SB025): PCBs	171KB002, 171KB004, 171KB005, 171KB007, 171KB008, 171KB010, 171KB011, 171KB013, 171KB016 - 171KB018, 171KB020 – 171KB024): PCBs **Sediment**: **SWMU 170**: 4 sediment samples (170M0001 – 170M0004): PCBs **SWMU 171**: 2 sediment samples (171M0001, 171M0002): PCBs

Nature and Extent of Contaminants

Forty-one sample locations associated with SWMUs 170 and 171 were evaluated for the presence of contaminants in 1995 and 1996. Of the 41 locations, nine are within the boundaries of Drainage Basin 28. Surface, subsurface, sediment, and asphalt samples were collected and analyzed for PCBs in order to delineate the nature and extent of potential contamination attributable to PCB removal operations associated with previous activities at the site. Aroclor-1260 was detected at two surface sample locations, however, the area of contamination was very limited and no further action was recommended.

4.11.1.2 AOC 520

Site Description and History

AOC 520 was a garbage storehouse for the barracks from the 1920s until the 1940s. Currently, the site is an asphalt parking area just north of Building M-17. A confirmatory sampling investigation (CSI) was performed at AOC 520 to identify impacts to soil resulting from storage and handling of garbage on site.

Previous Investigations

The RFI is the only investigation that has been conducted for AOC 520. A summary of investigative activities is presented in Table 4.11.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Zone C RFI Report*.

Table 4.11.3
Summary of AOC 520 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 - 1997	Site Investigation of soil.	
		Round 1 **Soil:** 6 surface borings (0 to 1 foot) 6 subsurface borings) soil borings (1 duplicate (520SB001 – 520SB006): metals, SVOCs, VOCs, cyanide, pesticides, PCBs.	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1995 - 1997	***Round 2*** **Soil:** 2 surface soil borings (0 to 1 foot) (520SB007, 520SB008): pesticides	***Round 2*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Eight sample locations associated with AOC 520 were evaluated for the presence of contaminants in 1995. The eight locations are all within the boundaries of Drainage Basin 28. Surface and subsurface samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the garbage house and previous activities at the site. Of particular interest were detections of chlordane in surface soil.

4.11.1.3 AOC 522
Site Description and History

AOC 522 is the site of former Building 1252, a grease and wash building located at the southeast corner of Building 198, near the loading docks. A CSI was performed at AOC 522 to identify impacts to soil resulting from activities at the site.

Previous Investigations

The RFI is the only investigation that has been conducted for AOC 522. A summary of investigative activities is presented in Table 4.11.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results prior to 2000 are presented in the *Zone C RFI Report* (EnSafe, 1997).

Table 4.11.4
Summary of AOC 522 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1998	Site Investigation of soil and groundwater.	
		Round 1 **Soil**: 5 surface borings (0 to 1 foot) 5 subsurface borings soil borings (1 duplicate) (522SB001 – 522SB005): metals, SVOCs, VOCs, cyanide, pesticides, PCBs.	***Round 1*** **Groundwater**: 3 geoprobe samples (522GP001 – 522GP003): VOCs.
CH2M-Jones	2001	***Round 1*** **Soil**: 2 surface borings (0 to 1 foot) (GDLSB012 – GDLSB013): metals, SVOCs	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Eight sample locations associated with AOC 522 were evaluated for the presence of contaminants in between 1996 and 1998. The eight locations are all within the boundaries of Drainage Basin 28. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the grease and wash building and previous activities at the site. Of particular interest were detections of methylene chloride in subsurface soil.

4.11.1.4 AOC 523

Site Description and History

AOC 523 (M-1234) operated as a gas station from 1958 until 1962. AOC 523 is beneath the southeast portion of Building 198 and a CSI was performed to identify impacts to soil or groundwater from possible petroleum releases from a UST or other unknown releases onsite.

Previous Investigations

The RFI is the only investigation that has been conducted for AOC 523. A summary of investigative activities is presented in Table 4.11.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Zone C RFI Report*.

Table 4.11.5
Summary of AOC 523 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 - 1996	Site Investigation of soil.	
		Round 1 **Soil**: 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (1 duplicate) (523SB001, 523SB002): metals, SVOCs, VOCs, pesticides, PCBs, cyanide, TPH.	***Round 1*** **Groundwater**: 2 shallow wells (523001, 523002): metals, SVOCs, VOCs, pesticides, PCBs, cyanide, TPH.
RFI (EnSafe)	1995 - 1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 2 shallow wells (523001, 523002): metals, TPH.
RFI (EnSafe)	1995 - 1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (523001, 523002): metals, TPH.
RFI (EnSafe)	1995 - 1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (523001, 523002): metals, TPH.

Nature and Extent of Contaminants

Four sample locations associated with AOC 523 were evaluated for the presence of contaminants in 1995 and 1996. The four locations are all within the boundaries of Drainage Basin 28. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the former gas station and previous activities at the site. Of particular interest were detections of arsenic in shallow groundwater. Based on analytical results, shallow groundwater was recommended for CMS.

4.11.1.5 AOC 559

Site Description and History

AOC 559 was combined into one investigative unit with AOC 560 and AOC 561 because of their close proximity. AOC 559 is the Central Power Station (Building 32) located at the intersection of Hobson Avenue and McMillan Avenue, adjacent to the McMillan gate entrance. The site is a three-story brick and concrete structure that has historically burned coal, fuel oil, and diesel fuel. The building was constructed in 1909 for steam and electric generation.

Previous Investigations

The RFI is the only investigation that has been conducted at AOC 559. A summary of investigative activities is presented in Table 4.11.6, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone E RFI Report*.

Table 4.11.6
Summary of AOC 559 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 - 1996	Site investigation of soil and groundwater	
		Round 1 **Soil**: 22 surface borings (0 to 1 foot) (3 duplicates) 21 subsurface borings (0 to 3 feet)	***Round 1*** **Groundwater**: 5 shallow wells (559001 – 559005), 3 deep wells (55902D – 55904D): metals, SVOCs, VOCs.

Table 4.11.6
Summary of AOC 559 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		(559SB001 – 559SB022): metals, SVOCs, VOCs, pesticides, PCBs, cyanide.	**Wipe Samples**: 10 wipe samples collected from surface areas (559JF00101 – 025JF00901, 559JF01101): PCBs
RFI (EnSafe)	1995 - 1996	***Round 2*** **Soil**: 6 surface borings (0 to 1 foot) 2 duplicates 6 subsurface soil borings (3 to 5 feet) (559SB023 – 559SB025, 559SB027 – 559SB029): metals, SVOCs, VOCs, pesticides, PCBs, cyanide.	***Round 2*** **Groundwater:** 5 shallow wells (559001 – 559005), 3 deep wells (55902D – 55904D): metals, SVOCs, VOCs.
RFI (EnSafe)	1995 - 1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 5 shallow wells (559001 – 559005), 3 deep wells (55902D – 55904D): metals, SVOCs, VOCs.
RFI (EnSafe)	1995 - 1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 5 shallow wells (559001 – 559005), 3 deep wells (55902D – 55904D): metals, SVOCs, VOCs.
CH2M-Jones	2001	***Round 1*** **Soil:** 1 surface boring (0 to 1 foot) (GDLSB010): metals, SVOCs	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Thirty-six sample locations associated with AOC 559 were evaluated for the presence of contaminants between 1996 and 1997. Of these 36, approximately 14 locations are within the boundaries of Drainage Basin 28. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the power station and previous activities at the site. Of particular interest were detections of arsenic, beryllium, PCBs, and BEQs in soil; benzene, chlorobenzene, 1,2-dichlorobenzene, and 1,4-dichlorobenzene in shallow groundwater; and trichloroethene and thallium in deep groundwater. Surface and subsurface soil and shallow and deep groundwater were recommended for CMS.

4.11.1.6 AOC 569, AOC 570, and AOC 578

Site Description and History

Due to their close proximity, AOCs 569, 570, and 578 were investigated as one site. AOC 569 is a former gas station and oil storehouse once located in Building 1279. The gas station was constructed in 1944 and had two pumps and two 2,500-gallon USTs. In 1986, an additional 3,000-gallon UST was installed. This site was demolished and the three tanks removed in 1992. Demolition activities consisted of pump and tank removal, filling vent lines, soil excavation, soil sampling, and resurfacing the area with asphalt.

AOC 570 was a coal storage which extended from Building 30 to Sixth Avenue and from Carolina Avenue to Hobson Avenue. The area was operational from 1919 to 1941, at which time coal was replaced by steam-power.

AOC 578 consists of a transportation shop and garage in Building 25. Built in 1940, the building was originally used as an automobile garage and more recently as a transportation and appliance maintenance shop. Building 25 housed the following facilities: air conditioning repair shop; sheet metal shop; two electric shops; paint shop; sign shop; carpenter's shop; paper shredding area; one restroom; electrical maintenance area; tool room; maintenance shop with personnel lockers; and emergency supply storage area.

Previous Investigations

A summary of investigative activities performed at combined AOC 569, AOC 570, and AOC 578 is presented in Table 4.11.7, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.11.7
Summary of AOC 569, AOC 570, and AOC 578 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Demolition and Tank Removal	1992	Performed to remove pumps and USTs associated with the gas station formerly located in Building 1279 (AOC 569) Organic Vapor Analysis (OVA) readings > 1000 parts per million (ppm). Sample data not available for review.	
Post-Tank Removal Confirmation Sampling	1993	Performed to determine levels of residual contamination potentially present in the vicinity of the former UST locations. Analytical results identified benzene, toluene, ethylbenzene, and xylene concentrations as high as 1,000 ppm. Sample data not available for review.	
RFI (EnSafe)	1995 – 1997	***Round 1*** **Soil:** 25 surface borings (0 to 1 foot) 25 subsurface borings (3 to 5 feet) (569SB001 – 569SB005, 570SB002 – 570SB004, 570SB006 – 570SB015, 578SB001 – 570SB006): VOCs, SVOCs, metals, and pH (570SB005): VOCs, SVOCs, metals, pesticides, PCBs, and cyanide (3 duplicates collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins	***Round 1*** **Groundwater:** 5 shallow wells (569001 – 569002, 570002 - 570003): VOCs, SVOCs, metals, chloride, sulfate, pH, and TDS (2 duplicate collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins (570001): VOCs, SVOCs, metals, pesticides, PCBs, chlorides, sulfates, cyanide, pH, and TDS
RFI (EnSafe)	1995 – 1997	***Round 2*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (569SB007): SVOCs, metals, TOC, and pH (570SB0A4): SVOCs and metals	***Round 2*** **Groundwater:** 5 shallow wells (569001 – 569002, 570001 - 570003): VOCs, SVOCs, metals, chlorides, sulfates, and TDS (2 duplicate collected for same parameters)
RFI (EnSafe)	1995 - 1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 6 shallow wells (569001 – 569002, 570001 – 570003): VOCs, metals, chlorides, sulfates, and TDS (2 duplicate collected for same parameters) 1 additional well installed (1996) (570004): VOCS, SVOCs, metals, pesticides, PCBs, chlorides, sulfates, cyanide, and TDS

Table 4.11.7
Summary of AOC 569, AOC 570, and AOC 578 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 - 1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 6 shallow wells (569001 – 569002, 570001 - 570003): VOCs, metals, chlorides, sulfates, and TDS (2 duplicate collected for same parameters) (1 duplicate collected for same parameters plus herbicides, pesticides, cyanide, and dioxins (570004): VOCS, SVOCs, metals, pesticides, PCBs, chlorides, sulfates, cyanide, and TDS
MNA (EnSafe)	1998	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 5 shallow wells (569001 – 569002, 570001, 570003): VOCs, sulfates, and TOC
MNA (EnSafe)	1998	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 6 shallow wells (569001 – 569002, 570001 - 570004): VOCs, nitrates, phosphorous, sulfates, sulfides, TKN, and TOC

Nature and Extent of Contaminants

Approximately 33 sample locations associated with AOC 569, AOC 570, and AOC 578 were evaluated for the presence of contaminants between 1995 and 1998. Of these 33, approximately 32 sample locations are within the boundaries of Drainage Basin 28. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of arsenic, benzene, BEQs, ethyl benzene, xylene in soil; and aluminum, chromium, lead, tetrachloroethene, thallium, and trichloroethene in groundwater. Based on analytical results and the human health risk assessment, a CMS was recommended for surface soil, subsurface soil, shallow groundwater and deep groundwater at the combined site.

4.11.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 28/8 on March 2, 2002 to determine if constituents are migrating from the AOC/SWMUs associated with Drainage Basin 28 into the Cooper River. Analytical detections for sample EFF019 are presented in Table 4.11.8.

Table 4.11.8
Storm Water Effluent Sampling Results
Drainage Basin 28

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
28	28/8	EFF019	Aluminum	98	3,277	NL	No
			Arsenic	15	6.88	36	No
			Barium	4.20	60.31	NL	No
			Calcium*	5,800	53,455	NL	No
			Chromium	4.60	13	50	No
			Copper	16	41.98	2.90	No
			Iron	190	4,134	NL	No
			Lead	3.30	33.63	8.50	No
			Magnesium*	6,000	49,255	NL	No
			Manganese	7.20	74.52	NL	No
			Potassium*	3,000	23,678	NL	No
			Sodium*	48,000	395,333	NL	No
			Vanadium	1.40	15.59	NL	No
			Zinc	74	307.83	86	No
			bis (2-Ethylhexyl) phthalate	**16**	**NL**	**NL**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.11.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 28. The Zone J data evaluation resulted in three possible outcomes based on the available data present for Drainage Basin 28. Table 4.11.9 summarizes the migration pathway scenarios.

Table 4.11.9
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 28

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.11.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. The EBS for Facility 198 states a release of an unspecified quantity of diesel fuel into the storm drain occurred in October 1986 and a release of approximately two gallons of paint into the storm drain occurred in January 1988.

Though past practices may make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF019 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.11.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 193 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone E background concentrations and the ecological risk based screening criteria did identified two sample location areas which have the potential to provide an upland source of bis(2-

Ethylhexyl)phthalate in the storm sewer system. However, these locations were collected down gradient of storm water effluent sample EFF019; therefore, this pathway is considered incomplete.

4.11.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 28 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with bis(2-Ethylhexyl)phthalate intercepting the storm water drainage pipeline within Drainage Basin 28.

4.11.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 28.

4.11.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 28 due to a lack of an upland terrestrial source identification.

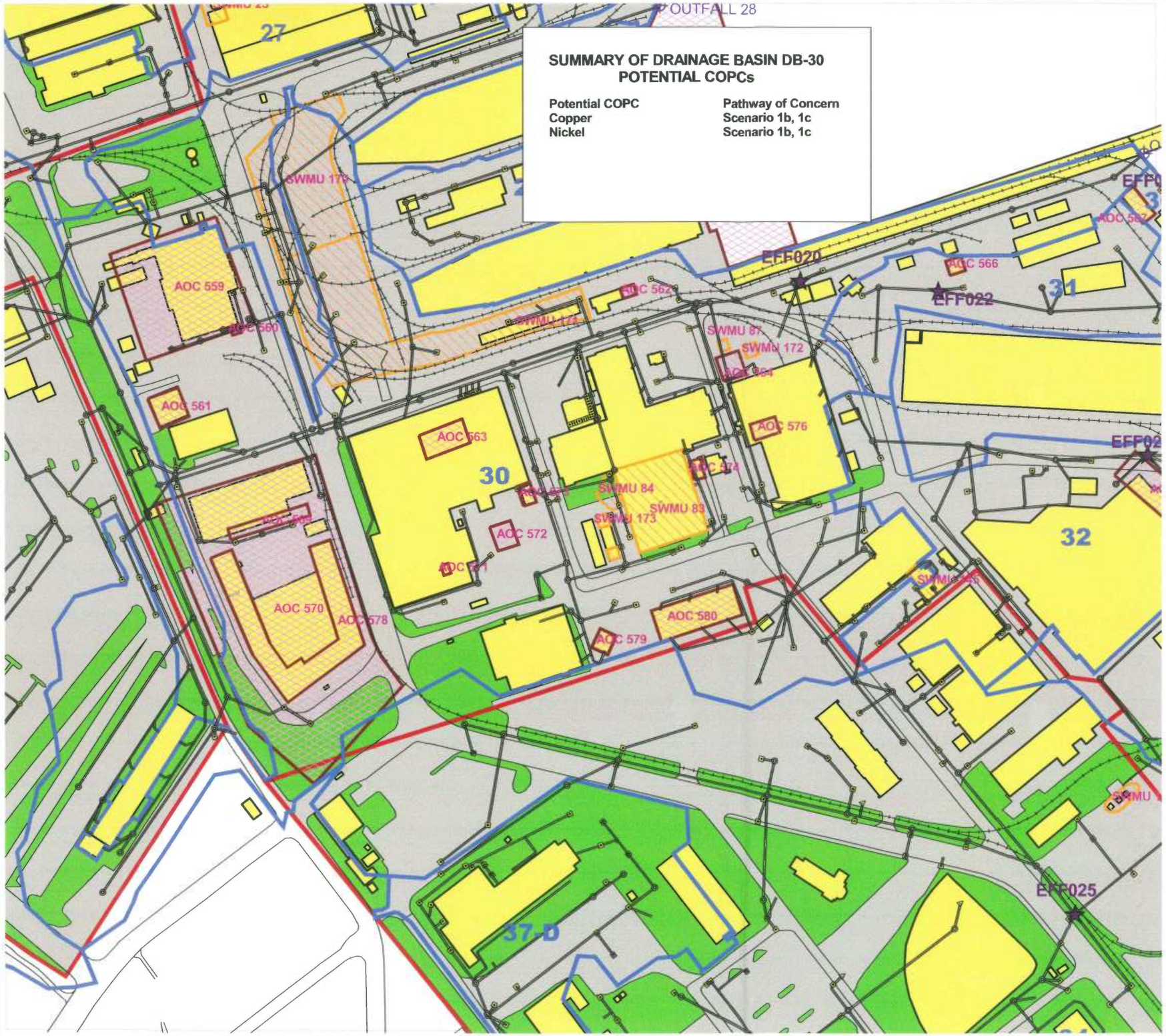
4.12 Drainage Basin 30

Drainage Basin 30 encompasses approximately 34 acres within Zone E located in the central section of the CNC. Land cover within the basin consists of approximately 17% unpaved surfaces, 31% paved surfaces, and 52% covered by building foundations. Storm water runoff within the drainage basin is directed to at least one of 106 catch basins connected to storm sewer pipelines that discharge into the Cooper River via Outfall 30.

Figure 4-12 illustrates the area encompassing Drainage Basin 30 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.12.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are 23 SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 30. The sites and their current RFI status are listed in Table 4.12.1. Three sites (SWMU 145, AOC 172 and AOC 173) were designated as no further action sites and were not included in the Zone J data evaluation. The remaining 20 sites include SWMU 83 (Foundry), SWMU 84 (Lead Storage), SWMU 87 (Less-than-90-Day Accumulation Area), SWMU 170 (Dry Dock No. 1, PCB Removal Area), SWMU 171 (Dry Dock No. 2, PCB Removal Area), AOC 559 (Central Power Station), AOC 560 (Disinfector), AOC 561 (Substation, Building 451B), AOC 562 (Substation), AOC 563 (Former Locomotive House), AOC 564 (Oil/Water Separator), AOC 569 (Gasoline Station and Oil Storage), AOC 570 (Former Coal Storage Area), AOC 572 (Building 177 Motor Area, AOC 573 (Anodizing Process Area), AOC 574 (Building 9 Fuel Tank), AOC 576 (Oil and Paint Storage/Print Office), AOC 578 (Transportation Shop and Garage), AOC 579 (Former Paint Shop), and AOC 580 (Former Pattern and Electric Shop). For this basin assessment, note that the following sites transcend the boundary of Drainage Basin 30 as follows: SWMU 170 to the northeast and to the west into Drainage Basin 28; SWMU 170 to the west into Drainage Basin 28; AOC 570 to the southeast into Drainage Basin 34 and to the west into Drainage Basin 28; and AOC 559 to the north into Drainage Basin 28. Although these site boundaries extend into other drainage basins, the sites primarily reside in Drainage Basin 30. Also note that due to their proximity to each other, the following sites were assessed together as grouped: SWMU 83, SWMU 84, and AOC 574; SWMU 87, SWMU 172, and



SUMMARY OF DRAINAGE BASIN DB-30 POTENTIAL COPCs

Potential COPC	Pathway of Concern
Copper	Scenario 1b, 1c
Nickel	Scenario 1b, 1c

N

200 0 200 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-12
Drainage Basin 30

January 2003 | Zone J Main Project.apr

AOC 564; SWMU 170 and SWMU 171; AOC 559, AOC 560, and AOC 561; and AOC 569, AOC 570, and AOC 578.

Table 4.12.1
Drainage Basin 30 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 83	Foundry	Draft RFI Report; Sampling and Analysis Plan for Combined SWMU 83; RFI Report Addendum; CMS Work Plan
SWMU 84	Lead Storage	Draft RFI Report; RFI Report Addendum; CMS Work Plan
SWMU 87	Less-than-90-Day Accumulation Area	Draft RFI Report
SWMU 145	Mercury Spill Area	RFI Report Addendum; CMS Investigation Report Addendum; NFA
SWMU 170	Dry Dock No. 1, PCB Removal Area	RFI Report Addendum; NFA
SWMU 171	Dry Dock No. 2, PCB Removal Area	NFA
SWMU 172	Building 80 Steam Cleaning Operation	NFA
SWMU 173	Building 1297 Storage Area	NFA
AOC 559	Central Power Station	Draft RFI Report; RFI Report Addendum; CMS Work Plan; NFA
AOC 560	Disinfector	Draft RFI Report; RFI Report Addendum; CMS Work Plan
AOC 561	Substation, Building 451B	Draft RFI Report; RFI Report Addendum; CMS Work Plan
AOC 562	Substation	Draft RFI Report; RFI Report Addendum; NFA
AOC 563	Former Locomotive House	Draft RFI Report
AOC 564	Oil/Water Separator	Draft RFI Report
AOC 569	Gasoline Station and Oil Storage	Draft RFI Report; Sampling and Analysis Plan
AOC 570	Former Coal Storage Area	Draft RFI Report; Sampling and Analysis Plan
AOC 572	Building 177 Motor Area	Draft RFI Report; Sampling and Analysis Plan; RFI Report Addendum
AOC 573	Anodizing Process Area	Draft RFI Report; Sampling and Analysis Plan
AOC 574	Building 9 Fuel Tank	Draft RFI Report; RFI Report Addendum; CMS Work Plan
AOC 576	Oil and Paint Storage/Print Office	Draft RFI Report; RFI Report Addendum; NFA
AOC 578	Transportation Shop and Garage	Draft RFI Report;
AOC 579	Former Paint Shop	Draft RFI Report; RFI Report Addendum
AOC 580	Former Pattern and Electric Shop	Draft RFI Report; RFI Report Addendum

4.12.1.1 Combined SWMU 83 (includes SWMU 84 and AOC 574)
Site Description and History

SWMU 83 is associated with a former foundry previously located in Building 9. The foundry was built in 1906 and used for melting and casting copper alloy parts. Potential materials of concern

associated with the area included: asbestos containing smoldering pots, lead bricks, a PCB contaminated oven, soot and metal scraps stored in a pit below an electrical oven, and drums of hazardous materials from previous operations. Foundry operations were discontinued in 1991. The building served a dual purpose as a repair area for hydraulic equipment and as a storage area for electrical power supply equipment.

SWMU 84 consists of an area outside of Building 9 used to store lead blankets and shielding. The majority of the lead was encased in either rubber or fabric; however, exposed lead materials have been stored in the area. The lead-containing materials were stored on pallets or directly on the concrete pavement. Containment structures were not utilized in the area.

AOC 574 is the site of a 3,700-gallon aboveground storage tank (AST) east of Building 9. The inactive fuel tank previously contained fuel oil used to operate furnaces and torches in Building 9. An interim measure was performed in this area by the Environmental Detachment (SPORTENVDETCHASN). A 15' x 20' x 4' area was excavated in order to remove petroleum contaminated soil identified at the site. The excavated area was lined with Geo-textile fabric, backfilled and groomed to prevent erosion. The removal action, completed in May 1997, resulted in the generation of approximately 45 cubic yards of petroleum contaminated soil waste, and was considered successful in meeting the removal objective.

Previous Investigations

A summary of investigative activities performed at Combined SWMU 83 is presented in Table 4.12.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone E RFI Report.*

Table 4.12.2
Summary of Combined SWMU 83 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Spill Investigation	1979	Completed to determine the PCB concentration of 100gallons of	No sample information available.

Table 4.12.2
Summary of Combined SWMU 83 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		transformer oil released southeast of Building 9.	
Spill Investigation	1988	Completed to determine PCB concentration of 0.5 gallons of oil/soot mixture spilled in rectifier area	
Spill Investigation	1988	**Wipe Samples:** 2 wipe samples: PCBs (results not available for review) Completed to determine extent of PCB contamination in the foundry Ajax oven	**Volumetric Samples:** 1 composite sample: PCBs (results not available for review)
Emissions Investigation	1988	**Wipe Samples:** 1 wipe sample: PCBs (results not available for review) Assessment of potential airborne contamination associated with PCB concentrations identified in the foundry Ajax oven	**Volumetric Samples** 2 samples: PCBs (results not available for review)
Spill Investigation	1989	**Air Samples:** 3 air samples: PCBs (results not available for review) Completed to assess PCB contamination around the drain plug and cement foundation of transformer NS1A cabinet	
Post-Cleanup Verification	1989	**Wipe Samples:** 2 wipe samples: PCBs (results not available for review) Post-cleanup verification of transformer NV1A cabinet drain plug and cement foundation area.	
Post-Cleanup Verification	1989	***Round 1*** **Wipe Samples:** 2 wipe samples: PCBs (results not available for review) ***Round 2*** **Wipes Samples:** 2 wipe samples: PCBs (results not available for review)	
Post-Cleanup Verification	1989	***Round 3*** **Wipe Samples;** 1 wipe sample: PCBs (results not available for review)	

Table 4.12.2
Summary of Combined SWMU 83 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation.	
		Round 1 **Soil:** 19 surface borings (0 to 1 foot) 19 subsurface borings (3 to 5 feet) (083SB001 – 083SB004, 083SB007 – 083SB008, 084SB001 – 084SB004, 084SB006, 574SB005): VOCs, SVOCs, metals, cyanide, pesticides, PCBs, and organotins (083SB005 – 083SB006, 084SB005, 574SB001 – 574SB004): VOCs, SVOCs, metals, pesticides, PCBs, cyanide, organotins, and TPH.	***Round 1*** **Groundwater:** 7 shallow wells (083001 – 083002, 084001 – 084002, 574001 – 574003): VOCs, SVOCS, metals, chlorides, sulfates, pesticides, PCBs, cyanide, organotins, and TDS (1 duplicate collected for same parameters plus herbicides, OP pesticides, hexavalent chromium, and dioxins.
RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** 8 surface borings (0 to 1 foot) 8 subsurface borings (3 to 5 feet) (084SB010, 084SB007 – 084SB009): VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and organotins (574SB006 – 574SB009): SVOCs, metals, pesticides, PCBs, and cyanide (1 duplicate collected for same parameters plus Appendix IX SVOCs and pesticides).	***Round 2*** **Groundwater:** 7 shallow wells (083001 – 083002, 574002 - 574003): SVOCS, metals, chlorides, sulfates, organotins, and TDS (084001 – 084002): metals, chlorides, sulfates, dioxins, and TDS (574001): SVOCs, metals, chlorides, sulfates, and TDS.
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 7 shallow wells (083001 – 083002, 084001 – 084002, 574001 - 574003): metals, chlorides, sulfates, and TDS
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 7 shallow wells (083001 – 083002, 084001 – 084002, 574001 - 574003): metals, chlorides, sulfates, and TDS.
MNA (EnSafe)	1998	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
MNA (EnSafe)	1998	***Round 2***	***Round 2***

Table 4.12.2
Summary of Combined SWMU 83 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		Soil:	**Groundwater:**
		No Soil Samples Collected.	1 shallow well (574001): VOCs, nitrates, phosphorous, sulfates, sulfides, TKN, and TOC

Nature and Extent of Contaminants

Approximately 70 sample locations associated with combined SWMU 83 were evaluated for the presence of contaminants between 1995 and 1998. All sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface, air, wipe, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of antimony, arsenic, BEQs, copper, dieldrin, lead in soil; and arsenic and thallium in groundwater. Based on the analytical results and the human health risk assessment for the site, a CMS was recommended for surface soil, subsurface soil, shallow groundwater and deep groundwater at combined SWMU 83.

4.12.1.2 Combined SWMU 87 (includes SWMU 172 and AOC 564)

Site Description and History

SWMU 87 consists of a former less-than-90-day accumulation area that was once part of the Charleston Naval Shipyard hazardous waste management system. Located north of Building 80, the site is a metal building with an asphalt foundation. Wastes were accumulated in closed, palletized plastic bags and 55-gallon drums. The accumulation area was taken out of service in March 1994.

SWMU 172 consists of a steam cleaning area north of Building 80. Steam cleaning has been performed in this area on various types of equipment including small engines, generators, and construction equipment. The site is a concrete/paved area designed with curbing and sloping surfaces to facilitate wastewater runoff. The site is not enclosed or roofed.

AOC 564 refers to a 300-gallon oil/water separator (OWS) north of Building 80. Wastewater from

machining and parts cleaning operations in Building 80 drained to a sloped, asphalt ramp, which feeds into an exterior drain connected to the OWS. The OWS had been in operation for more than 25 years.

Previous Investigations

A summary of investigative activities performed at combined SWMU 87/AOC 564 is presented in Table 4.12.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone E RFI Report.*

Table 4.12.3
Summary of Combined SWMU 87 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 -1997	Site soil and groundwater investigation	
		Round 1 **Soil:** 10 surface borings (0 to 1 foot) 10 subsurface borings (3 to 5 feet) (087SB001, 172SB001 – 172SB006, 564SB001 – 564SB003): VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and organotins) (2 duplicate samples collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins)	***Round 1*** **Groundwater:** 2 shallow wells (172001 and 172001): VOCs, SVOCs, metals, pesticides, PCBs, sulfate, chloride, cyanide, TDS, and organotins.
		Sediment: 1 sediment sample (172M0001): VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and organotins	
RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 2 shallow wells (172001): VOCs, SVOCs, metals, sulfate, chloride, and TDS (172002): VOCs, SVOCs, metals, sulfate, chloride, TDS, and organotins.

Table 4.12.3
Summary of Combined SWMU 87 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (172001): VOCs, SVOCs, metals, sulfate, chloride, and TDS (172002): VOCs, SVOCs, metals, sulfate, chloride, TDS, and organotins.
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (172001): VOCs, SVOCs, metals, sulfate, chloride, and TDS (172002): VOCs, SVOCs, metals, sulfate, chloride, TDS, and organotins. 1 deep well (17202D): VOCs, SVOCs, metals, sulfate, chloride, and TDS.
MNA (EnSafe)	1998	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 1 shallow well (172001): VOCs, sulfate, and TDS
MNA (EnSafe)	1998	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 2 shallow wells (172001 - 172002): VOCs, nitrate, phosphorous, sulfate, sulfide, TKN, and TOC.
CH2M-Jones	2002	***Round 1*** **Soil:** 12 surface borings (0 to 1 foot) (172SB008): metals, SVOCs, VOCs, and pesticides. (172SB009 – 172SB010): metals, and pesticides. (172SB011 – 172SB014): metals, SVOCs, and VOCs. (172SB015 – 172SB019): VOCs. 12 subsurface borings (3 to 5 feet) (172SB008 – 172SB010): metals and pesticides. (172SB011 – 172SB014): metals, SVOCs, and VOCs. (172SB015 – 172SB019): VOCs.	***Round 1*** **Groundwater:** 1 shallow well (172001): VOCs

Nature and Extent of Contaminants

Approximately 13 sample locations associated with combined SWMU 87 were evaluated for the presence of contaminants between 1995 and 1998. All sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface, sediment and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the combined site. Of particular interest were detections of BEQs, and dieldrin in soil and arsenic, chlorobenzene, 1,4-dichlorobenzene, 1,2-dichloroethene, manganese, thallium, trichloroethene, and vinyl chloride groundwater. Based on analytical results and the human health risk assessment, a CMS was recommended for surface soil, shallow groundwater and deep groundwater at combined SWMU 87.

4.12.1.3 Combined SWMU 170 (includes SWMU 171)

Site Description and History

SWMUs 170 and 171 consist of storage areas immediately west of Dry Dock No.1 and Dry Dock No.2, respectively. Missile launching tubes removed from decommissioned ballistic missile submarines were stored in these areas for removal of PCB-containing components. The missile tube dismantling areas were not equipped with secondary containment. It is estimated that missile tube dismantlement began around the late 1980s.

Previous Investigations

A summary of investigative activities performed at combined SWMU 170 is presented in Table 4.12.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report.*

Table 4.12.4
Summary of Combined SWMU 170 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
RFI (EnSafe)	1995 - 1997	Site soil and groundwater investigation.

Table 4.12.4
Summary of Combined SWMU 170 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		Round 1 **Soil:** 35 surface borings (0 to 1 foot) 27 subsurface borings (3 to 5 feet) (170SB002 – 170SB007, 170SB010, 171SB002 – 171SB003, 171SB005 – 171SB016, 171SB019 – 171SB023, 171SB025): PCBs (170SB001, 170SB008 –170SB009, 170SB011, 170SB013 – 170SB015): VOCs and PCBs (170SB012): VOCs, PCBs, and TPH (7 duplicates collected for same parameters plus herbicides, OP pesticides, hexavalent chromium, and dioxins) **Sediment:** 6 sediment sample (572M0001): PCBs	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 73 sample locations associated with combined SWMU 170 were evaluated for the presence of contaminants between 1995 and 1997. Of these 73, approximately 64 sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface, sediment, and asphalt samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Although Aroclor-1260 was detected in two surface soil locations at concentrations above residential RGOs, the area of contamination was limited and the mean risk considered negligible. Based on analytical results and the human health risk assessment, no further action was recommended for combined SWMU 170.

4.12.1.4 AOC 559, AOC 560, and AOC 561
Site Description and History

AOC 559 consists of Building 32, the Central Power Station, which is a three-story brick and concrete structure with concrete floors. The building was constructed in 1909 for steam and electric generation. The power plan has historically burned coal, fuel oil, and diesel fuel.

AOC 560 refers to the former site of Building 34. Historical base maps from the 1920s and 1930s illustrate the building as a "disinfector". It is believed that the disinfector treated water prior to use in the power plant or treated steam with a rust inhibitor after it was generated.

AOC 561, designated Building 451B, is a substation that was constructed in 1944. The substation consists of three parts: a weatherproof, metal enclosure containing the switch gear; a pad-mounted, high-voltage transformer with feed towers; and a battery bank housed in a two-room area. The substation was one of the principal feeds for electrical power to the shipyard and the controlled industrial area (CIA).

Previous Investigations

A summary of investigative activities performed at AOC 559, AOC 560, and AOC 561 is presented in Table 4.12.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone E RFI Report*.

Table 4.12.5
Summary of AOC 559, AOC 560, and AOC 561 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 -1997	Site soil and groundwater investigation	
		Round 1 **Soil:** 28 surface borings (0 to 1 foot) 26 subsurface borings (3 to 5 feet) (559SB001 – 559SB022, 560SB001 – 560SB002, 561SB001 – 561SB002, 561SB004 – 561SB005): VOCs, SVOCs, metals, pesticides, PCBs and	***Round 1*** **Groundwater:** 5 shallow wells (559001 and 559004): VOCs, SVOCs, metals, chloride, sulfate, cyanide, and TDS (559005): VOCs, SVOCs, metals, pesticides, PCBs, chloride, sulfate,

Table 4.12.5
Summary of AOC 559, AOC 560, and AOC 561 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		cyanide (4 duplicate samples collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins.)	cyanide, and TDS.
RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** 7 surface borings (0 to 1 foot) 7 subsurface borings (3 to 5 feet) (559SB023 – 559SB025, 559SB027 – 559SB029, 561SB006): VOCs, SVOCs, metals, pesticides, PCBs and cyanide (3 duplicate samples collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins)	***Round 2*** **Groundwater:** 5 shallow wells (559001 and 559005): VOCs, SVOCs, metals, chloride, sulfate, cyanide, and TDS.
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 5 shallow wells (559001 and 559005): VOCs, SVOCs, metals, chloride, sulfate, and TDS.
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 5 shallow wells (559001 and 559005): VOCs, SVOCs, metals, chloride, sulfate, and TDS.
CH2M-Jones	2001	***Round 1*** **Soil:** 4 surface borings (0 to 1 foot) (559SB041 – 559SB044): SVOCs. 3 subsurface borings (3 to 5 feet) (559SB041 – 559SB043): SVOCs.	***Round 1*** **Groundwater:** 3 shallow wells (561001M1 – 561002M1, and 559006L1): VOCs.
CH2M-Jones	2002	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 2 shallow wells (561003M2 – 561005M2): VOCs.
CH2M-Jones	2002	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 6 shallow wells (561003M3 – 561006M3): VOCs.
CH2M-Jones	2002	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (559006L1): VOCs.

Table 4.12.5
Summary of AOC 559, AOC 560, and AOC 561 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CH2M-Jones	2002	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 6 shallow wells (561001M4 – 561006M4, and 559006M4): VOCs.

Nature and Extent of Contaminants

Approximately 50 sample locations associated with combined AOC 559, AOC 560, and AOC 561 were evaluated for the presence of contaminants between 1995 and 2002. Of these 50, approximately 33 sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface, wipe, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the combined site. Of particular interest were detections of arsenic, Aroclor-1254, Aroclor-1260, BEQs, beryllium, and n-nitrosomethylethylamine in soil; benzene, chlorobenzene, 1,2-dichlorobenzene, and 1,4-dichlorobenzene in shallow groundwater; and thallium and trichlorobenzene in deep groundwater. Based on analytical results and the human health risk assessment, a CMS was recommended for surface soil, subsurface soil, shallow groundwater and deep groundwater at the combined site.

4.12.1.5 AOC 562
Site Description and History

AOC 562 is Building 84, an active electrical substation constructed in 1942. The building is a single-story structure with a concrete slab floor and roof. Adjacent to Building 84, several weatherproof metal-enclosed transformers are staged on a concrete slab encompassed by fencing. Reportedly, transformer leaks have occurred within the building. During a site inspection, stains were noted inside Building 84 as well as on the adjacent concrete pad area.

Previous Investigations

A summary of investigative activities performed at AOC 562 is presented in Table 4.12.6, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed

discussions and results are presented in the *Draft Zone E RFI Report.*

Table 4.12.6
Summary of AOC 562 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 - 1997	Soil and interior building surfaces investigation for the presence of contaminants, primarily PCBs.	
		Round 1 **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (562SB001- 562SB002, 562SB004): VOCs, PCBs.	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately seven sample locations associated with AOC 562 were evaluated for the presence of contaminants between 1995 and 1997. All sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface, and wipe samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site.

4.12.1.6 AOC 563
Site Description and History

AOC 563 is former Building 37, a locomotive maintenance house constructed in 1913 and in operation until 1939. Probable maintenance activities would have involved materials such as lubricants, chlorinated solvents and degreasers, and coal or petroleum fuels. Building 177 currently occupies the former site of Building 37.

Previous Investigations

A summary of investigative activities performed at AOC 563 is presented in Table 4.12.7, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report.*

Table 4.12.7
Summary of AOC 563 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation.	
		Round 1 **Soil:** 9 surface borings (0 to 1 foot) 9 subsurface borings (3 to 5 feet) (563SB001 – 563SB009): VOCs, SVOCS, pesticides, PCBs, metals, and cyanide (2 duplicates collected for same parameters plus herbicides, pesticides, hexavalent chromium, dioxins, and OP pesticides)	***Round 1*** **Groundwater:** 3 shallow wells (563001 – 563003): VOCs, SVOCs, pesticides, PCBs, metals, cyanides, chlorides, sulfates, and TDS.
RFI (EnSafe)	1995–1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 3 shallow wells (563001 – 563003): VOCs, SVOCs, metals, chlorides, sulfates, and TDS.
RFI (EnSafe)	1995–1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 3 shallow wells (563001 – 563003): VOCs, metals, chlorides, sulfates, and TDS.
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 3 shallow wells (563001 – 563003): VOCs, metals, chlorides, sulfates, and TDS.
MNA (EnSafe)	1998	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 3 shallow wells (563001 – 563003): VOCs, sulfate, and TOC.
MNA (EnSafe)	1998	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 3 shallow wells (563001 – 563003): VOCs, nitrate, phosphorous, sulfate, sulfide, TKN, and TOC.

Nature and Extent of Contaminants

Approximately 16 sample locations associated with AOC 563 were evaluated for the presence of

contaminants between 1995 and 1998. All sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface, wipe, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in soil; and arsenic and trichloroethene in groundwater. Based on analytical results and the human health risk assessment, a CMS was recommended for surface soil and shallow groundwater at AOC 563.

4.12.1.7 AOC 569, AOC 570, and AOC 578

Site Description and History

AOC 569 is a former gas station and oil storehouse once located in Building 1279. The gas station was constructed in 1944 and had two pumps and two 2,500-gallon USTs. In 1986, an additional 3,000-gallon UST was installed. This site was demolished and the three tanks removed in 1992. Demolition activities consisted of pump and tank removal, filling vent lines, soil excavation, soil sampling, and resurfacing the area with asphalt.

AOC 570 was a coal storage which extended from Building 30 to Sixth Avenue and from Carolina Avenue to Hobson Avenue. The area was operational from 1919 to 1941, at which time coal was replaced by steam-power.

AOC 578 consists of a transportation shop and garage in Building 25. Built in 1940, the building was originally used as an automobile garage and more recently as a transportation and appliance maintenance shop. Building 25 housed the following facilities: air conditioning repair shop; sheet metal shop; two electric shops; paint shop; sign shop; carpenter's shop; paper shredding area; one restroom; electrical maintenance area; tool room; maintenance shop with personnel lockers; and emergency supply storage area.

Previous Investigations

A summary of investigative activities performed at combined AOC 569, AOC 570, and AOC 578 is presented in Table 4.12.8, which contains the date of the activities, number of soil and shallow

groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone E RFI Report.*

Table 4.12.8
Summary of AOC 569, AOC 570, and AOC 578 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Demolition and Tank Removal	1992	Performed to remove pumps and USTs associated with the gas station formerly located in Building 1279 (AOC 569) OVA readings > 1000 ppm. Sample data not available for review.	
Post-Tank Removal Confirmation Sampling	1993	Performed to determine levels of residual contamination potentially present in the vicinity of the former UST locations. Analytical results identified benzene, toluene, ethylbenzene, and xylene concentrations as high as 1,000 ppm. Sample data not available for review.	
RFI (EnSafe)	1995 – 1997	***Round 1*** **Soil:** 25 surface borings (0 to 1 foot) 25 subsurface borings (3 to 5 feet) (569SB001 – 569SB005, 570SB002 – 570SB004, 570SB006 – 570SB015, 578SB001 – 570SB006): VOCs, SVOCs, metals, and pH (570SB005): VOCs, SVOCs, metals, pesticides, PCBs, and cyanide (3 duplicates collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins	***Round 1*** **Groundwater:** 5 shallow wells (569001 – 569002, 570002 - 570003): VOCs, SVOCs, metals, chloride, sulfate, pH, and TDS (2 duplicate collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins (570001): VOCs, SVOCs, metals, pesticides, PCBs, chlorides, sulfates, cyanide, pH, and TDS.
RFI (EnSafe)	1995 – 1997	***Round 2*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (569SB007): SVOCs, metals, TOC, and pH (570SB0A4): SVOCs and metals	***Round 2*** **Groundwater:** 5 shallow wells (569001 – 569002, 570001 - 570003): VOCs, SVOCs, metals, chlorides, sulfates, and TDS (2 duplicate collected for same parameters).
RFI (EnSafe)	1995 - 1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 6 shallow wells

Table 4.12.8
Summary of AOC 569, AOC 570, and AOC 578 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			(569001 – 569002, 570001 – 570003): VOCs, metals, chlorides, sulfates, and TDS (2 duplicate collected for same parameters) 1 additional well installed (1996) (570004): VOCS, SVOCs, metals, pesticides, PCBs, chlorides, sulfates, cyanide, and TDS.
RFI (EnSafe)	1995 - 1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 6 shallow wells (569001 – 569002, 570001 - 570003): VOCs, metals, chlorides, sulfates, and TDS (2 duplicate collected for same parameters) (1 duplicate collected for same parameters plus herbicides, pesticides, cyanide, and dioxins (570004): VOCS, SVOCs, metals, pesticides, PCBs, chlorides, sulfates, cyanide, and TDS.
MNA (EnSafe)	1998	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 5 shallow wells (569001 – 569002, 570001, 570003): VOCs, sulfates, and TOC.
MNA (EnSafe)	1998	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 6 shallow wells (569001 – 569002, 570001 - 570004): VOCs, nitrates, phosphorous, sulfates, sulfides, TKN, and TOC.
CH2M-Jones	2002	***Round 1*** **Soil:** 1 surface boring (0 to 1 foot) 1 subsurface boring (3 to 5 feet) (578SB001b and 578SB002b): metals.	***Round 1*** **Groundwater:** 3 shallow wells (569001M2 – 569002M2, 570001M2): VOCs.

Nature and Extent of Contaminants

Approximately 33 sample locations associated with AOC 569, AOC 570, and AOC 578 were

evaluated for the presence of contaminants between 1995 and 2002. Of these 33, approximately 32 sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of arsenic, benzene, BEQs, ethyl benzene, xylene in soil; and aluminum, chromium, lead, tetrachloroethene, thallium, and trichloroethene in groundwater. Based on analytical results and the human health risk assessment, a CMS was recommended for surface soil, subsurface soil, shallow groundwater and deep groundwater at the combined site.

4.12.1.8 AOC 572

Site Description and History

AOC 572 is a former electrical motor steam cleaning area south of Building 177. While in operation, no containment structures were utilized allowing wastewater to drain directly to the storm sewer system.

Previous Investigations

A summary of investigative activities performed at AOC 572 is presented in Table 4.12.9, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone E RFI Report.*

Table 4.12.9
Summary of AOC 572 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation.	
		Round 1 **Soil:** 8 surface borings (0 to 1 foot) 8 subsurface borings (3 to 5 feet) (572SB001 – 572SB008): VOCs, SVOCS, and metals	***Round 1*** **Groundwater:** 3 shallow wells (572001 – 572003): VOCs, SVOCs, metals, chlorides, sulfates, and TDS
		Sediment:	

Table 4.12.9
Summary of AOC 572 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		1 sediment sample (572M0001): VOCs, SVOCs, and metals	
RFI (EnSafe)	1995–1997	***Round 2*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (572SB009 – 572SB0011): SVOCS, and metals	***Round 2*** **Groundwater:** 3 shallow wells (572001 – 572003): VOCs, SVOCs, metals, chlorides, sulfates, and TDS
RFI (EnSafe)	1995–1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 3 shallow wells (572001 – 572003): VOCs, metals, chlorides, sulfates, and TDS
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 3 shallow wells (572001 – 572003): VOCs, metals, chlorides, sulfates, and TDS
MNA (EnSafe)	1998	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 1 shallow well (572002): VOCs, metals, chlorides, sulfates, and TDS
MNA (EnSafe)	1998	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (572002): VOCs, metals, chlorides, sulfates, and TDS
CH2M-Jones	2001	***Round 1*** **Soil:** 14 surface borings (0 to 1 foot) 14 subsurface borings (3 to 5 feet) (572SB012 – 572SB013 and 572SB018 – 572SB024): metals (572SB014 – 572SB017): SVOCs (572SB025): metals and SVOCs.	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 15 sample locations associated with AOC 572 were evaluated for the presence of contaminants between 1995 and 2001. All sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface, sediment, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site.

Of particular interest were detections of BEQs and lead in soil; arsenic and BEQs in sediment; and thallium in groundwater. Based on analytical results and the human health risk assessment, a CMS was recommended for surface soil, subsurface soil, sediment, and shallow groundwater at AOC 572.

4.12.1.9 AOC 573

Site Description and History

AOC 573 refers to an anodizing process conducted in a 3-sided metal attachment to Building 177, where metal parts and antennas were dipped or sprayed, and rinsed with tap water. The anodizing process included a 2,000-gallon irradiate (chromic acid solution) dipping tank and a spray area with a 110-gallon sump. The site is contained on three sides by a concrete berm and sloped back toward the sump on the fourth side. The sump was used to collect excess spray and rinse water. Prior to 1972, the sump was connected to the storm sewer.

Previous Investigations

A summary of investigative activities performed at AOC 573 is presented in Table 4.12.10, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.12.10
Summary of AOC 573 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation.	
		Round 1 **Soil:** 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (573SB001 – 573SB005): VOCs, SVOCS, metals, and pH (4 duplicates collected for same parameters plus herbicides, OP pesticides, hexavalent chromium, and dioxins)	***Round 1*** **Groundwater:** 1 shallow well (573001): VOCs, SVOCs, metals, chlorides, sulfates, and TDS (1 duplicate collected for same parameters plus herbicides, dioxin, OP pesticides, and hexavalent chromium).
		Sediment:	

Table 4.12.10
Summary of AOC 573 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		2 sediment sample (573M0001 – 573M0002): VOCs, SVOCs, metals, and pH	
RFI (EnSafe)	1995–1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (573001): chlorides, sulfates, metals, and TDS (1 duplicate collected for same parameters plus dioxins).
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 1 shallow well (573001): chlorides, sulfates, metals, and TDS (1 duplicate collected for same parameters).
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (573001): chlorides, sulfates, metals, and TDS (1 duplicate collected for same parameters).

Nature and Extent of Contaminants

Approximately eight sample locations associated with AOC 573 were evaluated for the presence of contaminants between 1995 and 1998. All sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface, sediment, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in soil; BEQs, arsenic, chromium, and lead. Based on analytical results and the human health risk assessment, a CMS was recommended for surface soil, sediment, and shallow groundwater at AOC 573.

4.12.1.10 AOC 576

Site Description and History

AOC 576 refers to an oil and paint storehouse/print office which was located in former Building 1012. The area was in operation from 1909 to 1930. Currently, this site is occupied by Building 80.

Previous Investigations

A summary of investigative activities performed at AOC 576 is presented in Table 4.12.11, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.12.11
Summary of AOC 576 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation.	
		Round 1 **Soil:** 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (576SB001 – 576SB005): VOCs, SVOCS, and metals (1 duplicate collected for same parameters plus herbicides, OP pesticides, hexavalent chromium, and dioxins)	***Round 1*** **Groundwater:** 2 shallow wells (576001 – 576002): VOCs, SVOCs, metals, chlorides, sulfates, and TDS (1 duplicate collected for VOCs, SVOCs, pesticides, PCBs, metals, and cyanides).
RFI (EnSafe)	1995–1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 2 shallow wells (576001): VOCs, SVOCs, metals, chlorides, sulfates, and TDS (576002): VOCs, SVOCs, and metals.
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (576001): VOCs, SVOCs, metals, chlorides, sulfates, and TDS (576002): VOCs, SVOCs, and metals.
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (576001): VOCs, SVOCs, metals, chlorides, sulfates, and TDS (576002): VOCs, SVOCs, and metals.
MNA (EnSafe)	1998	***Round 1*** **Soil:**	***Round 1*** **Groundwater:**

Table 4.12.11
Summary of AOC 576 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		No Soil Samples Collected.	2 shallow wells (576001 - 576002): VOCs, sulfate, and TOC.
MNA (EnSafe)	1998	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 2 shallow wells (576001 - 576002): VOCs, nitrate, phosphorous, sulfate, sulfide, TKN, and TOC.

Nature and Extent of Contaminants

Approximately seven sample locations associated with AOC 576 were evaluated for the presence of contaminants between 1995 and 1998. Of these seven, six sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in soil; and arsenic, beryllium, bromodichloromethane, and thallium in groundwater. Based on analytical results and the human health risk assessment, a CMS was recommended for surface soil, shallow groundwater, and deep groundwater at AOC 576.

4.12.1.11 AOC 579

Site Description and History

AOC 579 refers to a former paint shop which was located in Building 1035. Built in 1919, the building was used until 1943 for meat storage and inspection. From 1943 to 1955, the site was used as a cafeteria and storehouse. From 1955 until approximately 1977, paint was stored in the area. Currently, the site is used as an electrician's storehouse.

Previous Investigations

A summary of investigative activities performed at AOC 579 is presented in Table 4.12.12, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.12.12
Summary of AOC 579 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil investigation.	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (579SB001 – 579SB004): VOCs, SVOCS, and metals (1 duplicates collected for same parameters plus herbicides, OP pesticides, hexavalent chromium, and dioxins)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1995–1997	***Round 2*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (579005): SVOCs, metals, and TOC (579006): SVOCs and metals	***Round 2*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately six sample locations associated with AOC 579 were evaluated for the presence of contaminants between 1995 and 1997. All sample locations are within the boundaries of Drainage Basin 30. Surface, and subsurface soil samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of arsenic and BEQS in surface soil. Based on analytical results and the human health risk assessment, a CMS was recommended for surface soil at AOC 579.

4.12.1.12 AOC 580

Site Description and History

AOC 580 is a former pattern and electric shop, which was located in Building 10. Built in 1918, the building was used as a pattern and storage shop until 1935. From 1935 until 1955, the site was used as a pattern and electric shop. In the early 1980's, the area became the office for the Nuclear Engineering Department.

Previous Investigations

A summary of investigative activities performed at AOC 580 is presented in Table 4.12.13, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report.*

Table 4.12.13
Summary of AOC 580 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation.	
		Round 1 **Soil:** 6 surface borings (0 to 1 foot) 6 subsurface borings (3 to 5 feet) (580SB001 – 580SB006): VOCs, SVOCS, and metals (1 duplicates collected for same parameters plus herbicides, OP pesticides, hexavalent chromium, and dioxins).	***Round 1*** **Groundwater:** 2 shallow wells (580001 – 580002): VOCs, SVOCs, metals, sulfates, chlorides, and TDS (1 duplicate collected for same parameters plus herbicides, OP pesticides, hexavalent chromium, and dioxins).
RFI (EnSafe)	1995–1997	***Round 2*** **Soil:** 3 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (580SB007 – 580SB010): SVOCs and metals	***Round 2*** **Groundwater:** 2 shallow wells (580001 – 580002): VOCs, metals, sulfates, chlorides, and TDS (1 duplicate collected for same parameters plus dioxins).
RFI (EnSafe)	1995–1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (580001 – 580002): metals, sulfates, chlorides, and TDS (1 duplicate collected for same parameters).
RFI (EnSafe)	1995–1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (580001 – 580002): metals, sulfates, chlorides, and TDS (1 duplicate collected for same parameters).

Nature and Extent of Contaminants

Approximately 11 sample locations associated with AOC 579 were evaluated for the presence of

contaminants between 1995 and 1997. Of these 11, 10 sample locations are within the boundaries of Drainage Basin 30. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of antimony, arsenic, BEQs, copper, lead, manganese, and vanadium in soil; and arsenic and thallium in groundwater. Based on analytical results and the human health risk assessment, a CMS was recommended for surface soil, subsurface soil, shallow groundwater, and deep groundwater at AOC 580.

4.12.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at manhole 30/4 on June 18, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 30 into the Cooper River. Analytical detections for sample EFF020 are presented in Table 4.12.14.

Table 4.12.14
Storm Water Effluent Sampling Results
Drainage Basin 30

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L): Reference Concentration	Screening Value (μg/L): Chronic Saltwater Screening Value	Potential COPC
30	30/4	EFF020	Aluminum	590	3,277	NL	No
			Barium	13	60.31	NL	No
			Calcium*	2,600	53,455	NL	No
			Chromium	4.20	13	50	No
			Copper	**99**	**41.98**	**2.90**	**Yes**
			Iron	1,100	4,134	NL	No
			Lead	13	33.63	8.50	No
			Magnesium*	790	49,255	NL	No
			Manganese	22	74.52	NL	No
			Nickel	**12**	**5.14**	**8.30**	**Yes**
			Potassium*	600	23,678	NL	No
			Sodium*	5,900	395,333	NL	No
			Vanadium	5.60	15.59	NL	No
			Zinc	250	307.83	86	No
			Di-n-Butylphthalate	1.40	NL	3.40	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.12.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 30. Table 4.12.15 summarizes the migration pathway scenarios.

Table 4.12.15
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 30

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	Yes
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	Yes
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.12.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. Review of EBS states the following incidents and releases occurred within Drainage Basin 30:

- Facility 80; the EBS states that wastewater was released directly to the storm water sewer system via two storm drains located within close proximity to the area.
- Facility 301, Dry Dock # One; Environmental Incident Report Number 86-03 states that a 60 gallon lube oil spill occurred in January 1986.
- Facility 301; Environmental Incident Report Number 84-62 in October 1984 states that a mobile boiler had a spill.
- In April 1988 approximately 200 mL of ethylenediamine was spilled into Dry Dock One.
- In May 1984, approximately 3,000 gallons of 4 percent muriatic acid spilled into Dry Dock One and into the Cooper River.

- Environmental Incident Report Number 85-36 references an undisclosed quantity of discharge of freon to the storm drainage system.
- Maintenance operations at Dry Dock # 2 led to the collection of a sludge sample containing parts per million concentrations of arsenic, barium, cadmium, copper, chromium, lead, nickel, selenium, silver, and zinc.
- According to the 1991 Environmental Incident Report # 91-13, a portable sludge oil tank parked in the vicinity of Building 1298 had produced a "spill residue" close to a storm drain.
- In July 1991 at Facility 30, approximately 100 gallons of lube oil was spilled, with some of the spill reaching the Cooper River.
- In 1989 a chromic acid release to the storm water sewer system was reported following an antenna anodizing operation.
- The boiler waste water at Facility 32 was typically discharged to the storm water drainage system. Chemicals in the waste were caustic soda, sodium sulfite, disodium phosphate, and cyclohexylamine.
- According to the EBS, facility 317B (Wharf F) had various diesel, fuel, grease, and liquid waste spills which have occurred over the years.
- On August 20, 1990, Building 195 reported a paint waste spillage into the storm sewer adjacent to Building 195 and on July 21, 1977, a portable tank value was accidentally sheared off and approximately five gallons of residual oil was spilled, part of which entered the storm water sewer line. Sand bags and sorbent material were used to clean up most of the spill prior to reaching the Cooper River.

Though past practices may make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF020 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.12.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that at least one of 106 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone

E background concentrations and the ecological risk based screening criteria identified 24 existing areas which have the potential to provide an upland source of copper or nickel in the storm sewer system. Table 4.12.16 lists the locations that exceed screening criteria.

4.12.16
Drainage Basin 30
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPC	Concentration (mg/kg)	Screening Value (mg/kg)	Distance (ft) to Catch Basin
30/7/4/5/1-D	083SB002	Copper	136	120 (BKG)	5.4
30/7/4/3/1	084SB003	Copper	332	120 (BKG)	28.7
30/7/4/5/1-D	574SB008	Nickel	70.3	20 (BKG)	41.6
30/7/4/5/1-D	574SB008	Copper	933	120 (BKG)	41.6
30/7/4/5/1-D	574SB002*	Nickel	66.9	20 (BKG)	45.0
30/7/4/5/1-D	574SB002*	Copper	868	120 (BKG)	45.0
30/7/4/5/1-D	574SB003*	Nickel	48.2	20 (BKG)	12.3
30/7/4/5/1-D	574SB003*	Copper	1,260	120 (BKG)	12.3
30/7/1/3/1-B	083SB002	Copper	142	120 (BKG)	76.5
30/7/1/3/1-B	574SB004	Copper	292	120 (BKG)	81.2
30/7/4/3/1	083SB007	Copper	243	120 (BKG)	33.8
30/7/4/3/1-A	083SB010*	Copper	439	120 (BKG)	10.2
30/7/1-A	087SB001*	Copper	142	120 (BKG)	62.5
30/18/2	559SB016*	Copper	136	120 (BKG)	80.3
30/17/4-A	570SB002*	Copper	192	120 (BKG)	89.6
30/12/4-A	572SB003*	Copper	155	120 (BKG)	16.1
30/7/4/3-C	573SB005*	Copper	236	120 (BKG)	15.7
30/7/1/3/1	574SB001*	Copper	1,180	120 (BKG)	50.5
30/7/1/3/1	574SB005*	Nickel	25.6	20 (BKG)	7.4
30/7/1/3/1	574SB005*	Copper	729	120 (BKG)	7.4
30/7/1/3-B	574SB005*	Copper	602	120 (BKG)	14.6
30/7/1/4-A	574SB007*	Copper	631	120 (BKG)	18.2
30/7/4/6-B	579SB002*	Nickel	31.9	20 (BKG)	103.9
30/7/4/6-B	579SB002*	Copper	686	120 (BKG)	103.9
30/7/4/6-B	580SB003*	Copper	122	120 (BKG)	47.4
30/7/1/5/1-A	580SB006	Copper	739	120 (BKG)	38.8
30/7/1/5-C	580SB009*	Copper	136	120 (BKG)	42.6

Notes:
* = Sample location is located under pavement and constituents from these locations most likely do not represent complete exposure pathways to the storm water system.

Evaluation of surface soil data to determine possible upland terrestrial source identification with EFF020 COPCs revealed that copper, and nickel were detected in surface soil above screening criteria at locations from 5 to 76.5 feet from catch basins within Drainage Basin 30. While many of the sample locations included in the table above are from locations that are covered by pavement and

do not represent a complete pathway, six locations were in grassy areas where contaminants could travel via sheet flow to the catch basin they were closest to (Figure 4-12A). Therefore, the pathway is complete for copper and nickel.

4.12.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 30 were reviewed. The preliminary evaluation identified groundwater contaminated with nickel or copper intercepting the storm water drainage pipeline within Drainage Basin 30 (Table 4.12.17).

4.12.17
Drainage Basin 30
Scenario 1c Evaluation
Charleston Naval Complex, South Carolina

Drainage Basin	Well ID	COPCs Consistent w/EFF018	Concentrations (µg/L)	Screening Value (µg/L)	Distance to EFF018
30/7/4/5/1-D	083002	Copper	9.60	6 (BKG)	5.4 ft. Upgradient
30/6	172002	Nickel	9.30	8 (BKG)	63.7 ft. Downgradient
30/7/4/1	563001	Copper	8.80	6 (BKG)	61.1 ft. Upgradient
30/7/6-B	563003	Nickel	8.80	8 (BKG)	91.9 ft. Downgradient
31/5-A	566001	Nickel	8.10	8 (BKG)	68.5 ft. Downgradient
30/14/2	569001	Copper	7.70	6 (BKG)	29.6 ft. Upgradient
30/17/4-A	570002	Copper	23.3	6 (BKG)	91.0 ft. Downgradient
30/17/4-A	570002	Nickel	17	8 (BKG)	91.0 ft. Downgradient
30/7/1A-C	576GW001	Nickel	67.8	8 (BKG)	13.2 ft. upgradient

200 0 200 Feet

N

LEGEND

- Soil Linkage Sample
- Surface Soil Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-12A
Drainage Basin 30
Soil Sample Linkage Locations

November 2002 | Zone J Main Project.apr

Evaluation of groundwater data to determine possible upland terrestrial source identification with EFF020 revealed that copper and nickel were detected in groundwater above the screening criteria upgradient and downgradient of the storm water line. Therefore, the pathway is complete for the two COPCs listed above. Figure 4-12B illustrates the groundwater locations that exceed screening criteria.

4.12.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study, the *Zone L RFI Report,* and *Process Closure for SWMU 37 Dye Test Cross-connect Resolution in Buildings 3, 9, and 68* Completion Report (Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP) Nov, 1998) indicates that there were cross-connects present from Building 9 in Drainage Basin 30. Many of the Building 9 cross-connects were subsequently eliminated prior to publication of the Completion Report. However, no information was found in the completion report regarding elimination of cross-connects in a restroom facility located in Building 9. Cross-connects from Buildings 13 and 177 were also reported from the Zone L dye test program. No information regarding the status of these cross-connects was found.

4.12.4 Summary of Potential COPC

Table 4.12.18 summarizes the potential COPCs that have been included for further characterization during the COPC Refinement process for the Cooper River.

Table 4.12.18
Summary of Potential COPCs
Drainage Basin 30

Potential COPC	Pathway of Concern
Copper	Scenario 1b Scenario 1c
Nickel	Scenario 1b Scenario 1c

200 0 200 Feet

N

LEGEND

- Groundwater Linkage Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Naval Facilities Engineering Command Southern Division

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-12B
Drainage Basin 30
Groundwater Sample Linkage Locations

November 2002 | Zone J Main Project.apr

4.13 Drainage Basin 30A

Drainage Basin 30A encompasses approximately 0.2 acres within Zone E of the CNC. Land cover within the basin consists of approximately 55% paved surfaces and 45% covered by building foundations. Most storm water runoff within the drainage basin is directed to one catch basin connected to the storm sewer pipeline that discharges into the Cooper River at Outfall 30A.

Figure 4-13 illustrates the area encompassing Drainage Basin 30A and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.13.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there is one AOC within the boundary of Drainage Basin 30A. AOC 567 (Substation, Building 75) is listed in Table 4.13.1 with its current status. The boundary of AOC 567 transcends the boundary of Drainage Basin 30A along the southwest where it extends into Drainage Basin 31.

Table 4.13.1
Drainage Basin 30A AOC 567
Charleston Naval Complex, Charleston, South Carolina

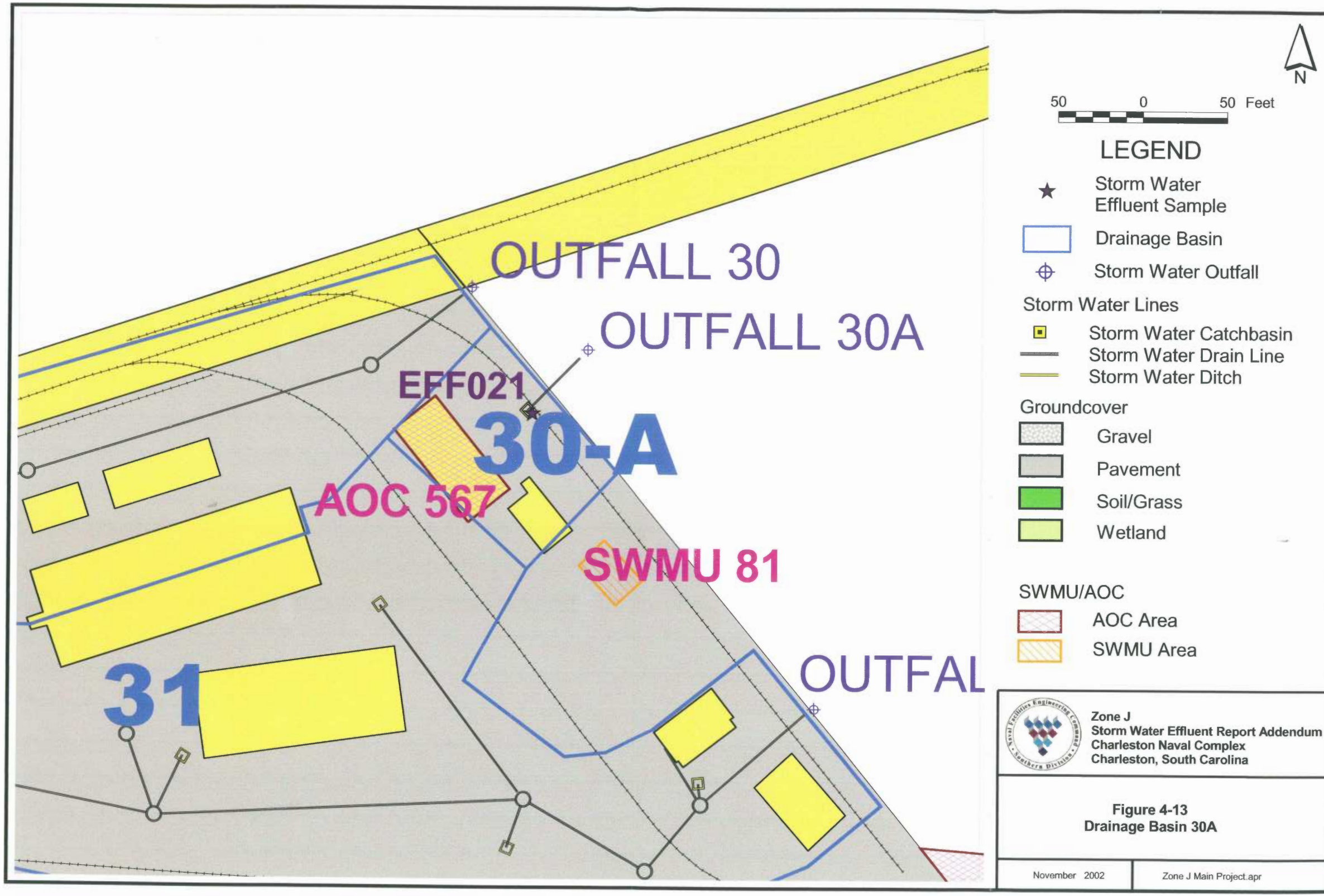
AOC	Site Name	RCRA Permit Status
AOC 567	Substation, Building 75	Draft RFI Report; RFI Report Addendum

4.13.1.1 AOC 567

Site Description and History

AOC 567 is Building 75, an electrical substation constructed in 1942 that remained active during the 1996-97 RFI. The site is located in an area bound by Wharf F, Pier F, and the Cooper River to the north, Building 26 and the Copper River to the east, railroad tracks and Building 247 to the south, and railroad tracks and Building 195 to the west. Adjacent to Building 75 is a concrete slab within a fenced area containing several weatherproof metal-enclosed transformers. The north side of Building 75 houses high-voltage switches, transformers, and a battery bank that provides emergency power for the facility. The transformer in operation during the RFI did not contain PCBs.

Previous Investigations


N
50 0 50 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
OUTFALL 30
OUTFALL 30A
EFF021
30-A
AOC 567
SWMU 81
31
OUTFAL
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-13
Drainage Basin 30A
November 2002
Zone J Main Project.apr

The RFI is the only investigation that has been conducted for AOC 567. A summary of investigative activities is presented in Table 4.13.2, which contains a summary of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.13.2
Summary of AOC 567 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil	
		Soil: 4 surface borings (0 to 1 foot) (567SB001 - 567SB004) 3 subsurface borings (3 to 5 feet) (except 567SB001): PCBs, metals	**Groundwater:** No Groundwater Samples Collected

Nature and Extent of Contaminants

Four sample locations associated with AOC 567 were evaluated for the presence of contaminants in 1995 and 1997. Of the four locations, two are within the boundaries of Drainage Basin 30A. Surface, subsurface, and wipe samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the electrical substation and previous activities at the site. Based on results of the RFI, no further action was recommended for AOC 567.

4.13.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 30A-A on June 22, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 30A into the Cooper River. Analytical detections for sample EFF021 are presented in Table 4.13.3.

Table 4.13.3
Storm Water Effluent Sampling Results
Drainage Basin 30A

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
30A	30A-A	EFF021	Aluminum	460	3,277	NL	No
			Barium	33	60.31	NL	No
			Cadmium	0.60	1.29	9.30	No
			Calcium*	4,200	53,455	NL	No
			Chromium	5.30	13.00	50.00	No
			Copper	**190**	**41.98**	**2.90**	**Yes**
			Iron	720	4,134	NL	No
			Lead	30	33.63	8.50	No
			Magnesium*	240	49,255	NL	No
			Manganese	10	74.52	NL	No
			Nickel	1.90	5.14	8.30	No
			Potassium*	490	23,678	NL	No
			Silver	0.50	2.30	0.23	No
			Sodium*	860	395,333	NL	No
			Vanadium	3.10	15.59	NL	No
			Zinc	180	307.83	86	No
			Benzo(g,h,i) perylene	**10**	**NL**	**NL**	**Yes**
			Phenol	16	NL	58	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.13.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 30A. Table 4.13.4 summarizes the migration pathway scenarios.

Table 4.13.4
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 30A

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	No
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.13.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. No releases impacting the storm water sewer system within the boundaries of Drainage Basin 30A were discovered during review of environmental incident reports that were maintained by the former CNSY Environmental Office Code 106 between the time period from 1982 until base closure in 1996, and EBS reports prepared for property transfer. Therefore, this pathway is considered incomplete.

4.13.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one catch basin is near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone E background concentrations and the ecological risk based screening criteria has identified one sample location areas which has the potential to provide an upland source of EFF021 COPCs for entry into the storm sewer system. A summary of this evaluation is provided in Table 4.13.5.

Table 4.13.5
Drainage Basin 30A
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Value (mg/kg)	Distance to Catch Basin#
30A-A	567SB001	Copper	127	120 (BKG)	47

Evaluation of surface soil data to determine possible upland terrestrial source identification with EFF021 COPCs revealed that copper was detected in soil above screening criteria at a location within 47 feet from Catch basin 30A-A. It should be noted that the sample was collected in an area completely covered with pavement and therefore contaminants in surface soils at this location could not reach the catch basin via sheet flow. Since the soil samples associated with AOC 567 were not analyzed for SVOCs, no upland terrestrial linkage of benzo(g,h,i)perylene could be identified during the data evaluation. Therefore, the pathway is incomplete.

4.13.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 30A were reviewed. The preliminary evaluation did not identify any groundwater sample locations within Drainage Basin 30A.

4.13.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from

the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 30A.

4.13.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 30A due to a lack of an upland terrestrial source identification.

4.14 Drainage Basin 31

Drainage Basin 31 encompasses approximately 3 acres within Zone E of the CNC. Land cover within the basin consists of approximately 80% paved surfaces and 20% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the 14 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 31.

Figure 4-14 illustrates the area encompassing Drainage Basin 31 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.14.1 Potential Source Areas

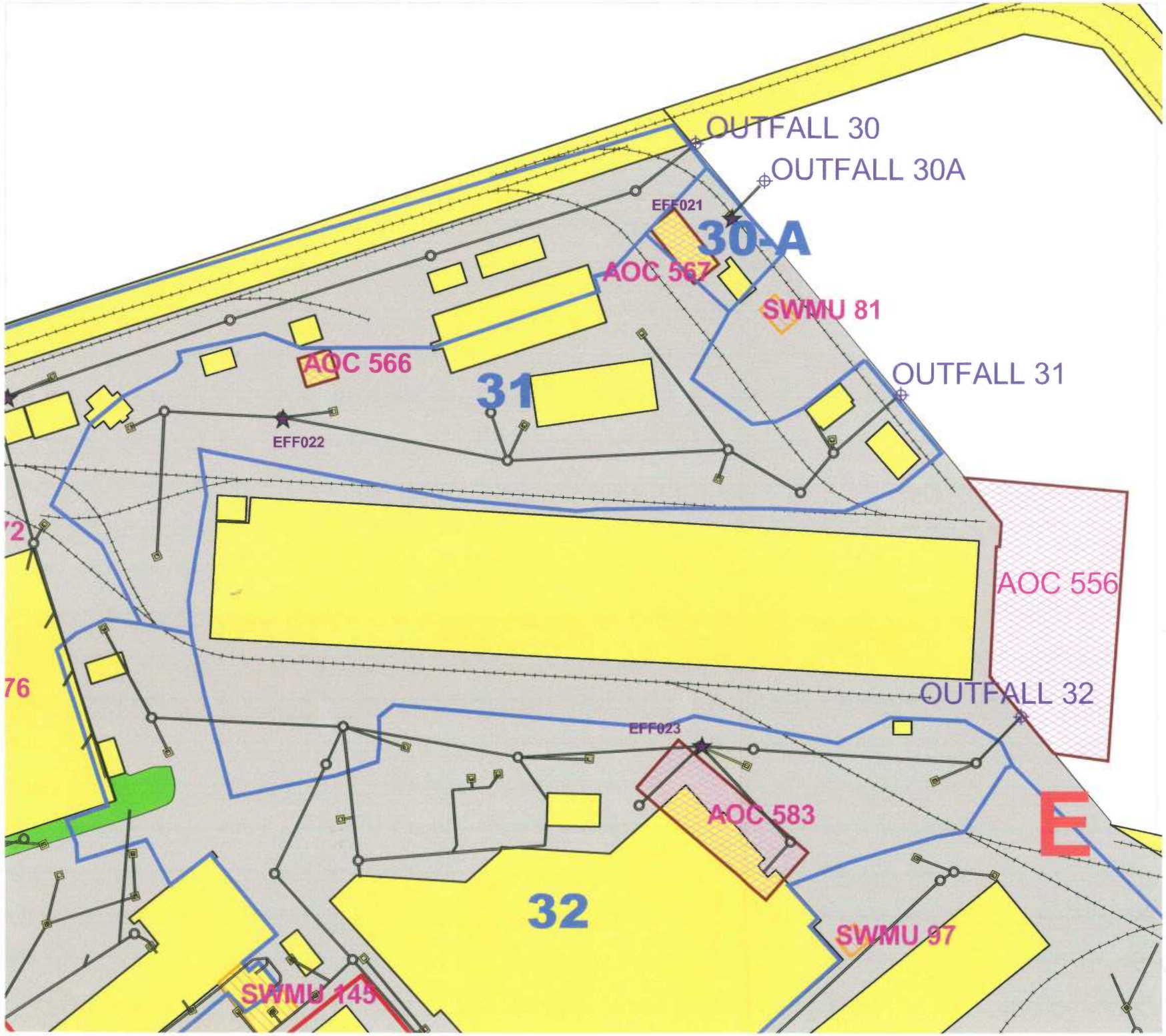
A review of the listing of sites found in Appendix A of the Part B Permit indicates there are two AOCs partly or completely within the boundary of Drainage Basin 31. The sites are listed in Table 4.14.1 with the current status of each site. These potential source areas include AOC 566 (Paint Shop Storage, Building 194) and AOC 567 (Substation, Building 75). AOC 566 is entirely located within Drainage Basin 31. The majority of AOC 567 is located in Drainage Basin 30-A, however, one sample in the southwest boundary of AOC 567 extends into Drainage Basin 31, therefore the evaluation of AOC 567 will be limited to this sample location.

Table 4.14.1
Drainage Basin 31 AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 566	Paint Storage Shop, Building 194	Draft RFI Report; RFI Report Addendum; NFA
AOC 567	Substation, Building 75	Draft RFI Report; RFI Report Addendum

4.14.1.1 AOC 566
Site Description and History

AOC 566, a former plant storage area in Building 194, was used by the Navy to store supplies such as tools, hoses, and equipment. Building 194 was constructed in 1964 and was used to store unused blasting grit and paints. AOC 566 is bounded on the north by Building 1802, on the east by Building 195, on the south by Dry Dock No. 5, and on the west by pavement. Waste paints were stored in the Satellite Accumulation Area (SAA) in the eastern portion of the building.



N

100 0 100 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-14
Drainage Basin 31

November 2002 | Zone J Main Project.apr

Previous Investigations

The RFI is the only investigation that has been conducted for AOC 566. A summary of investigative activities is presented in Table 4.14.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report.*

Table 4.14.2
Summary of AOC 566 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 – 1997	Site investigation of soil and groundwater.	
	1995	***Round 1*** **Soil**: 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (566SB001 - 566SB005): VOCs, SVOCs, metals	***Round 1*** **Groundwater**: No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (566001): VOCs, SVOCs, metals, chlorides, sulfates, and TDS
RFI (EnSafe)	1996	***Round 3*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (566SB006 and 566SB007): VOCs, SVOCs, metals, pesticide/PCBs, cyanide	***Round 3*** **Groundwater:** 1 shallow well (566001): metals, chlorides, sulfates, and TDS
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (566001): metals, chlorides, sulfates, and TDS
RFI (EnSafe)	1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (566001): metals, chlorides, sulfates, and TDS

Nature and Extent of Contamination

Eight sample locations associated with AOC 566 were evaluated for the presence of contaminants between 1995 and 1997. Of the eight locations, 4 are within the boundaries of Drainage Basin 31.

Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to paint storage and previous activities at the site. Of particular interest were detections of BEQs in soil, and arsenic, beryllium, and thallium in groundwater. Surface and subsurface soil, and shallow and deep groundwater were recommended for CMS.

4.14.1.2 AOC 567

Site Description and History

AOC 567 is Building 75, an electrical substation constructed in 1942 that remained active during the 1996-1997 RFI. The site is located in an area bound by Wharf F, Pier F, and the Cooper River to the north, Building 26 and the Copper River to the east, railroad tracks and Building 247 to the south, and railroad tracks and Building 195 to the west. Adjacent to Building 75 is a concrete slab within a fenced area containing several weatherproof metal-enclosed transformers. The north side of Building 75 houses high-voltage switches, transformers, and a battery bank that provides emergency power for the facility. The transformer in operation during the RFI did not contain PCBs.

Previous Investigations

The RFI is the only investigation that has been conducted for AOC 567. A summary of investigative activities is presented in Table 4.14.3, which contains a summary of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report.*

Table 4.14.3
Summary of AOC 567 Investigation
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil.	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) (567SB001 - 567SB004): PCBs, metals 3 subsurface borings (3 to 5 feet)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Table 4.14.3
Summary of AOC 567 Investigation
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
		(567SB002 – 567SB004): PCBs, metals

Nature and Extent of Contamination

Four sample locations associated with AOC 567 were evaluated for the presence of contaminants in 1996. Of the four locations, one is within the boundaries of Drainage Basin 31. Surface, subsurface, and wipe samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the electrical substation and previous activities at the site. Based on results of the RFI, no further action was recommended for AOC 567.

4.14.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 31/5 on June 22, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 31 into the Cooper River. Analytical detections for sample EFF022 are presented in Table 4.14.4.

Table 4.14.4
Storm Water Effluent Sampling Results
Drainage Basin 31

					Screening Value (μg/L)		
Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Reference Concentration	Chronic Saltwater Screening Value	Potential COPC
31	31/5	EFF022	Aluminum	280	3,277	NL	No
			Barium	60	60.31	NL	No
			Calcium*	5,500	53,455	NL	No
			Chromium	1.90	13	50	No
			Cobalt	**2.80**	**2.00**	**NL**	**Yes**
			Copper	**46**	**41.98**	**2.90**	**Yes**
			Iron	1,100	4,134	NL	No
			Lead	3.30	33.63	8.50	No
			Magnesium*	570	49,255	NL	No
			Manganese	27	74.52	NL	No
			Nickel	**240**	**5.14**	**8.30**	**Yes**

Table 4.14.4
Storm Water Effluent Sampling Results
Drainage Basin 31

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
			Potassium*	760	23,678	NL	No
			Sodium*	4,900	395,333	NL	No
			Vanadium	**130**	**15.59**	**NL**	**Yes**
			Zinc	**340**	**307.83**	**86**	**Yes**
			alpha-BHC	0.023	NL	1,400	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.14.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 31 Table 4.14.5 summarizes the migration pathway scenarios.

Table 4.14.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 31

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.14.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS, facility 317B (Wharf F) had various diesel, fuel, grease, and liquid waste spills which have occurred over

the years. On August 20, 1990, Building 195 reported a paint waste spillage into the storm sewer adjacent to Building 195 and on July 21, 1977, a portable tank value was accidentally sheared off and approximately five gallons of residual oil was spilled, part of which entered the storm water sewer line. Sand bags and sorbent material were used to clean up most of the spill prior to reaching the Cooper River.

During the EBS assessment it was noticed that the areas surrounding Building 194 were heavily stained with paint and ground-in sandblast grit from the time when the area was used as to prepare new blasting grit and for mixing paint. Wash down operations may have transferred contaminants into the storm water sewer system; though there is no specific evidence of this.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF022 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.14.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 14 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone E background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source for the COPCs identified in Table 4.14.4 in the storm sewer system.

4.14.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater

(infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 31 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with COPCs identified in Table 4.14.4 intercepting the storm water drainage pipeline within Drainage Basin 31.

4.14.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 31.

4.14.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 31 due to a lack of an upland terrestrial source identification.

4.15 Drainage Basin 32

Drainage Basin 32 encompasses approximately 6.5 acres within Zone E in the central section of the CNC. Land cover within the basin consists of approximately 2% unpaved surfaces, 38% paved

surfaces, and 60% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the 30 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 32.

Figure 4-15 illustrates the area encompassing Drainage Basin 32 and associated RCRA sites, storm water effluent locations and storm water drainage features.

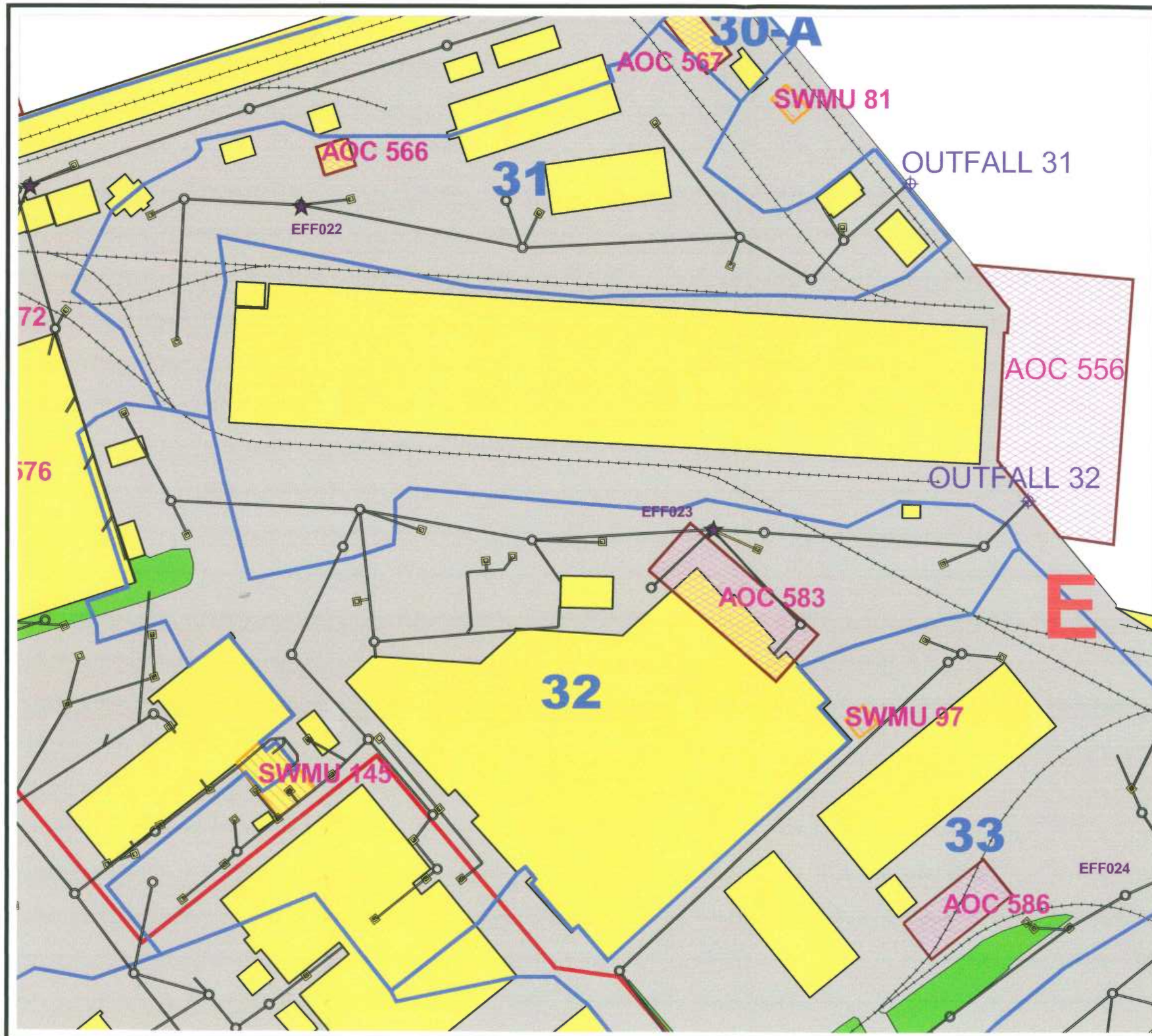
4.15.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are four SWMUs/AOCs that are either partially or completely within the boundary of Drainage Basin 32. The sites are listed in Table 4.15.1 with the current status of each site. AOC 583 (Northeast Corner of Building 236) and SWMU 188 (SAA, Paint Waste, Southside of Dry Dock #5, Midway) are located completely within the boundary of Drainage Basin 32. Although portions of SWMU 145 (Mercury Spill Area) and AOC 576 (Oil and Paint Storehouse/Print Office) are located in Drainage Basin 30, sample points associated with these sites fall within the boundary of Drainage Basin 32. The evaluation of SWMU 145 and AOC 576, as it relates to Drainage Basin 32, will be limited to these sample locations.

Table 4.15.1
Drainage Basin 32 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 145	Mercury Spill Area	Draft RFI Report; RFI Report Addendum; CMS Investigation Report Addendum; NFA
SWMU 188	SAA, Paint Waste, Southside of Dry Dock #5, Midway	RFI Addendum Sampling Plan; RFI Report Addendum
AOC 576	Oil and Paint Storehouse/Print House	Draft RFI Report; RFI Addendum; NFA
AOC 583	Northeast Corner of Building 236	Draft RFI Report; RFI Report Addendum

4.15.1.1 SWMU 145
Site Description and History



N

100 0 100 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-15
Drainage Basin 32

November 2002 | Zone J Main Project.apr

SWMU 145 is a mercury spill reportedly under a portion of Building 13A. No additional information could be found regarding the date, amount, or duration of the release(s). Building 13A is an extension of the southeast corner of Building 13 and is bound to the north by Building 13, Building 87 to the south, Building 1746 to the east, and Building 217 to the west.

Previous Investigations

A summary of investigative activities is presented in Table 4.15.2, which contains a summary of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.15.2
Summary of SWMU 145 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1997	Site investigation of soil and groundwater.	
	1996	***Round 1*** **Soil**: 12 surface borings (0 to 1 foot) 12 subsurface borings (3 to 5 feet) (145SB001 - 145SB012): Mercury	***Round 1*** **Groundwater**: No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil**: No Soil Samples Collected.	***Round 2*** **Groundwater**: 3 shallow wells (145001 – 145003): metals, chlorides, sulfates
RFI (EnSafe)	1996	***Round 3*** **Soil**: No Soil Samples Collected.	***Round 3*** **Groundwater**: 3 shallow wells (145001 – 145003): Dioxins, general chemistry
RFI (EnSafe)	1996	***Round 4*** **Soil**: No Soil Samples Collected.	***Round 4*** **Groundwater**: 3 shallow wells (145001 – 145003): metals, general chemistry
RFI (EnSafe)	1997	***Round 5*** **Soil**: No Soil Samples Collected.	***Round 5*** **Groundwater**: 3 shallow wells (145001 – 145003): metals, general chemistry

Nature and Extent of Contaminants

Fifteen sample locations associated with SWMU 145 were evaluated for the presence of contaminants in 1996 and 1997. Of the 15 locations, 11 are within the boundaries of Drainage Basin 32. Surface, subsurface, and groundwater samples were collected and analyzed for metals in order to delineate the nature and extent of potential contamination attributable to the mercury spill and previous activities at the site. Of particular interest were detections of arsenic in deep groundwater. Deep groundwater was recommended for CMS.

4.15.1.2 SWMU 188

SWMU 188 is the former location of a SAA on the south side of Dry Dock 5. It was an element of the Charleston Naval Ship Yard hazardous waste management system, where hazardous wastes were accumulated in accordance with 40 CFR 262.34(c) and South Carolina Hazardous Waste Management Regulations (SCHWMR) R.61-79.262.34(c). Hazardous waste was then transferred to Building 1640, a permitted facility where hazardous wastes generated base-wide were stored prior to shipment offsite for treatment and/or disposal. This SAA was an 8' x 6' x 6' metal storage structure which was permitted on September 6, 1994, and removed prior to 1996. A review of the Navy's spill and inspection reports did not indicate any releases from this site; however, there was some evidence of paint spills and petroleum-like stains that were contained inside the SAA. Several large stains were noted on the asphalt surface approximately 20 feet southeast of the unit.

Previous Investigations

A summary of investigative activities is presented in Table 4.15.3, which contains a summary of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *RFI Report Addendum* (CH2M-Jones).

Table 4.15.3
Summary of SWMU 188 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations

Table 4.15.3
Summary of SWMU 188 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CH2M-Jones	2002	Site investigation of soil.	
		Round 1 **Soil**: 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (188SB001 - 188SB005): VOCs, SVOCs, metals, pesticides,PCBs, cyanide	***Round 1*** **Groundwater**: No Groundwater Samples Collected.

Nature and Extent of Contaminants

Three sample locations associated with SWMU 188 were evaluated for the presence of contaminants in 2002. All three locations are within the boundaries of Drainage Basin 32. Surface and subsurface soil samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the previous activities at the site.

4.15.1.3 AOC 576

Site Description and History

AOC 576, an oil and paint storehouse/print office, was in former Building 1012. Operations were conducted from 1909 until 1930. Currently, this site is occupied by Building 80 and is bound by Building 80 to the north and east, Avenue "A" South to the south, and Building 9 to the west.

Previous Investigations

A summary of investigative activities is presented in Table 4.15.4, which contains a summary of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.15.4
Summary of AOC 576 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
RFI (EnSafe)	1995 – 1997	Site investigation of soil and

Table 4.15.4
Summary of AOC 576 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		groundwater.	
	1995	***Round 1*** **Soil**: 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (576SB001 - 576SB005): VOCs, SVOCs, metals	***Round 1*** **Groundwater**: No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil**: No Soil Samples Collected.	***Round 2*** **Groundwater**: 2 shallow wells (576001): VOCs, metals, general chemistry (576002): VOCs, SVOCs, metals, general chemistry
RFI (EnSafe)	1996	***Round 3*** **Soil**: No Soil Samples Collected.	***Round 3*** **Groundwater**: 2 shallow wells (576001): VOCs, SVOCs, metals, general chemistry (576002): VOCs, SVOCs, metals
RFI (EnSafe)	1997	***Round 4*** **Soil**: No Soil Samples Collected.	***Round 4*** **Groundwater**: 2 shallow wells (576001): VOCs, SVOCs, metals, general chemistry (576002): VOCs, SVOCs, metals
RFI (EnSafe)	1998	***Round 5*** **Soil**: No Soil Samples Collected.	***Round 5*** **Groundwater**: 2 shallow wells (576001): VOCs, SVOCs, metals, general chemistry (576002): VOCs, SVOCs, metals
RFI (EnSafe)	1998	***Round 6*** **Soil**: No Soil Samples Collected.	***Round 6*** **Groundwater**: 2 shallow wells (576001): VOCs (576002): VOCs
RFI (EnSafe)	1998	***Round 7*** **Soil**: No Soil Samples Collected.	***Round 7*** **Groundwater**: 2 shallow wells (576001): VOCs (576002): VOCs

Nature and Extent of Contaminants

Seven sample locations associated with AOC 576 were evaluated for the presence of contaminants

in 1996 and 1997. Of the seven locations, two are within the boundaries of Drainage Basin 32. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the storage of oil and paint and previous printing activities at the site. Of particular interest were BEQs in soil and arsenic, beryllium, thallium, and bromodichloromethane in groundwater. Surface soil, shallow, and deep groundwater were recommended for CMS.

4.15.1.4 AOC 583

Site Description and History

AOC 583 is located on the northeast corner of Building 236, approximately 150 feet south of Dry Dock No. 5, and is associated with activities conducted in this area. Building 236 resides on the southeast corner of the Pierside Street/Dry Dock Avenue intersection and was constructed in 1982. The north side of the building houses conference rooms, offices, a locker room, and a pipe-fitting shop. The shop area contained a freon recycling/distillation unit, associated piping and three USTs. Five USTs, located outside the northeast corner of the building and used to contain petroleum products, were investigated and determined in 1998 to require no further action.

Previous Investigations

A summary of investigative activities is presented in Table 4.15.5, which contains a summary of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.15.5
Summary of AOC 583 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 – 1997	Site investigation of soil and groundwater.	
	1995	***Round 1*** **Soil**: 7 surface borings (0 to 1 foot) 7 subsurface borings (3 to 5 feet) (583SB001 - 583SB007): metals,	***Round 1*** **Groundwater**: No Groundwater Samples Collected.

Table 4.15.5
Summary of AOC 583 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		SVOCs, VOCs (1 duplicate collected for the same parameters)	
RFI (EnSafe)	1996 - 1997	***Round 2*** **Soil**: No Soil Samples Collected.	***Round 2*** **Groundwater**: 3 shallow wells (583001 - 583003): chlorides, sulfates, TDS, SVOCs, VOCs metals
RFI (EnSafe)	1996 - 1997	***Round 3*** **Soil:** 1 surface borings (0 to 1 foot) (583SB008): cyanide, metals, pesticides, PCBs, SVOCs, VOCs, general chemistry 1 subsurface boring (3 to 5 feet) (583SB008): cyanide, metals, pesticides, PCBs, SVOCs, VOCs	***Round 3*** **Groundwater**: No Groundwater Samples Collected.
RFI (EnSafe)	1996 - 1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater**: 3 shallow wells (583001 - 583003): chlorides, sulfates, TDS, VOCs metals
RFI (EnSafe)	1996 - 1997	***Round 5*** **Soil:** 2 surface borings (0 to 1 foot) (583SB009): general chemistry (583SB010): metals	***Round 5*** **Groundwater**: No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater**: 3 shallow wells (583001 - 583003): chlorides, sulfates, TDS, metals
RFI (EnSafe)	1997	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater**: 3 shallow wells (583001 - 583003): chlorides, sulfates, TDS, metals

Nature and Extent of Contaminants

Thirteen sample locations associated with AOC 576 were evaluated for the presence of contaminants between 1995 and 1997. All locations are within the boundaries of Drainage Basin 32. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the previous activities at

the site. Of particular interest were BEQs in soil and thallium in groundwater. Surface soil and shallow and deep groundwater were recommended for CMS.

4.15.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 32/2 on June 22, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 32 into the Cooper River. Analytical detections for sample EFF023 are presented in Table 4.15.6.

Table 4.15.6
Storm Water Effluent Sampling Results
Drainage Basin 32

					Screening Value (μg/L)		
Drainage Basin	**Catch Basin/ Manhole ID**	**Sample ID**	**Parameter**	**Concentration (μg/L)**	**Reference Concentration**	**Chronic Saltwater Screening Value**	**Potential COPC**
32	32/2	EFF023	Aluminum	110	3,277	NL	No
			Barium	11	60.31	NL	No
			Calcium*	2,000	53,455	NL	No
			Chromium	1.90	13	50	No
			Copper	27	41.98	2.90	No
			Iron	170	4,134	NL	No
			Magnesium*	720	49,255	NL	No
			Manganese	6.50	74.52	NL	No
			Potassium*	390	23,678	NL	No
			Sodium*	5,400	395,333	NL	No
			Vanadium	1.40	15.59	NL	No
			Zinc	130	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.15.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 32. Table 4.14.7 summarizes the migration pathway scenarios.

Table 4.15.7
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 32

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.15.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. In November 1986 approximately 200 gallons of rinsate containing paint stripper was discharged outside the northeast end of Building 236 to a storm drain. Though a past release may make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF023 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

There were no potential storm water effluent COPCs identified for Drainage Basin 32 that require further characterization; therefore contaminant migration pathway scenarios 1b through 1d do not require further evaluation.

4.16 Drainage Basin 33

Drainage Basin 33 encompasses approximately 5 acres within Zone E in the central section of the CNC. Land cover within the basin consists of approximately 15% unpaved surfaces, 55% paved surfaces, and 30% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the 16 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 33.

Figure 4-16 illustrates the area encompassing Drainage Basin 33 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.16.1 Potential Source Areas

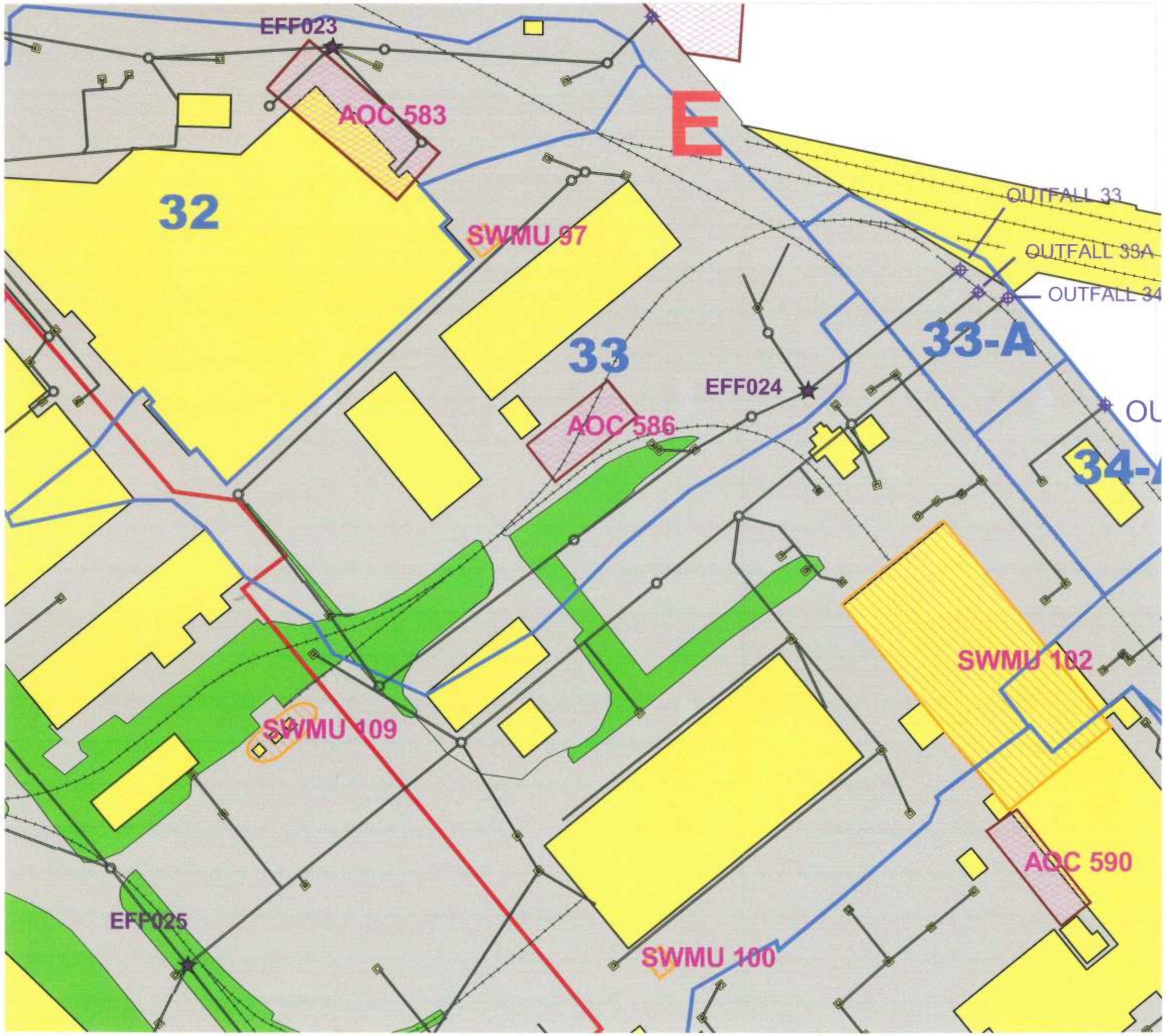
A review of the listing of sites found in Appendix A of the Part B Permit indicates there are two SWMUs/AOCs that are either partially or completely within the boundary of Drainage Basin 33. The sites are listed in Table 4.16.1 with the current status of each site. All sites were included in the Zone J data evaluation. These sites include SWMU 97 (Less than 90-Day Accumulation Area) and AOC 586 (Temporary Power House).

Table 4.16.1
Drainage Basin 33 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 97	Less than 90-Day Accumulation Area	Draft RFI Report; RFI Report Addendum; NFA
AOC 586	Temporary Powerhouse	Draft RFI Report; RFI Report Addendum

4.16.1.1 SWMU 97
Site Description and History

SWMU 97 is located on the west side of Pierside Street, approximately 34 feet north of Building 11 and 8 feet east of Building 236. The site is bound by an asphalt parking lot to the north, Building 236 to the south and west, and Building 11 to the east. It is a 20' X 20" metal structure on an asphalt foundation formerly used as a less than 90-day storage area. Hazardous wastes were containerized and stored on pallets inside the structure. The time frame during which the area was utilized is



N

100 0 100 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-16
Drainage Basin 33

November 2002 | Zone J Main Project.apr

unknown. The storage area is currently empty.

Previous Investigations

For SWMU 97, the RFI is the only investigation that has been conducted for this site. A summary of investigative activities is presented in Table 4.16.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report.*

Table 4.16.2
Summary of SWMU 97 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1997	Site investigation of soil and groundwater.	
		Round 1 **Soil**: 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (097SB001-097SB003): cyanide, metals, organotins, pesticides, PCBs, SVOCs, VOCs.	***Round 1*** **Groundwater:** 1 shallow well (097001): chlorides, cyanide, metals, organotins, pesticides, PCBs, sulfates, SVOCs, TDS, VOCs
RFI (EnSafe)	1996 - 1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Rounds 2,3,4*** **Groundwater:** 1 shallow well (097001): metals, organotins.

Nature and Extent of Contaminants

Four sample locations associated with SWMU 97 were evaluated for the presence of contaminants in 1996 and 1997. All four of the sample locations are within the boundaries of Drainage Basin 33. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the less than 90-day accumulation area and previous activities at the site. Based on results of the RFI, no further action was recommended.

4.16.1.2 AOC 586

Site Description and History

AOC 586 is located in an area bounded by Building 11 to the north and west, Necessary Lane to the south, and Pierside Street to the east. The area is associated with a temporary powerhouse constructed in 1905, originally Building 1014. In 1944, Building 1014 was connected to Building 1077 and the combined structure used for industrial salvage. Information regarding prior operating practices at the facility was unavailable. Building 1014 was demolished around 1957. Currently, the site is a concrete slab adjacent to the southeast corner of Building 11.

Previous Investigations

For AOC 586, the RFI is the only investigation that has been conducted for this site. A summary of investigative activities is presented in Table 4.16.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report.*

Table 4.16.3
Summary of AOC 586 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1997	Site investigation of soil and groundwater.	
		Round 1 **Soil**: 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (586SB001-586SB004): metals, pH, PCBs, SVOCs, VOCs	***Round 1*** **Groundwater:** 1 shallow well (586001): metals, pH, PCBs, SVOCs, TDS, VOCs
RFI (EnSafe)	1996 - 1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Rounds 2, 3, 4*** **Groundwater:** 1 shallow well (586001): metals, pH, PCBs, SVOCs, TDS, VOCs

Nature and Extent of Contaminants

Five sample locations associated with AOC 586 were evaluated for the presence of contaminants in 1996 and 1997. All five of the sample locations associated with AOC 586 are within the boundaries

of Drainage Basin 33. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the temporary powerhouse and previous activities at the site. Of particular interest were detections of Aroclor-1260 (PCBs) and BEQs in soil.

4.16.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 33/1 on June 18, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 33 into the Cooper River. Analytical detections for sample EFF024 are presented in Table 4.16.4.

Table 4.16.4
Storm Water Effluent Sampling Results
Drainage Basin 33

					Screening Value (μg/L)		
Drainage Basin	**Catch Basin/ Manhole ID**	**Sample ID**	**Parameter**	**Concentration (μg/L)**	**Reference Concentration**	**Chronic Saltwater Screening Value**	**Potential COPC**
33	33/1	EFF024	Aluminum	860	3,277	NL	No
			Barium	16	60.31	NL	No
			Calcium*	6,300	53,455	NL	No
			Chromium	8.20	13	50	No
			Cobalt	1.10	2.00	NL	No
			Copper	**160**	**41.98**	**2.90**	**Yes**
			Iron	1,900	4,134	NL	No
			Lead	20	33.63	8.50	No
			Magnesium*	11,00	49,255	NL	No
			Manganese	**90**	**74.52**	**NL**	**Yes**
			Nickel	5.50	5.14	8.30	No
			Potassium*	1,700	23,678	NL	No
			Sodium*	5,600	395,333	NL	No
			Vanadium	6.50	15.59	NL	No
			Zinc	300	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.16.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 33. Table 4.16.5 summarizes the migration pathway scenarios.

Table 4.16.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 33

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.16.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. Building 236, the location of several USTs at the northeast corner of the building, had a release in November 1986 of approximately 200 gallons of fuel oil to the storm drain. Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF024 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at this facility.

4.16.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 16 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone

E background concentrations and the ecological risk based screening criteria identified two sample locations which have the potential to provide an upland identification consistent with EFF024 COPCs for entry into the storm sewer system. A summary of this evaluation is provided in Table 4.16.6.

Table 4.16.6
Drainage Basin 33
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Value (mg/kg)	Distance to Catch Basin#
33/2	*586SB001	Manganese	202	200 (BKG)	148.9
33/2	*586SB002	Manganese	431	200 (BKG)	133.9

Notes:
* = Sample location is located under pavement and constituents from these locations most likely do not represent complete exposure pathways to the storm water system.

Evaluation of surface soil data to determine possible upland terrestrial source identification with EFF024 COPCs revealed that manganese and iron were detected in surface soil above screening criteria at locations within 134 to 149 feet from catch basin 33/2. However, all of these soil sample locations are located under pavement and constituents from these locations most likely do not represent a complete exposure pathway to the storm water system via sheet flow. Therefore, Scenario 1b is not considered complete for the COPCs listed in table 4.16.4.

4.16.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 33

were reviewed. The preliminary evaluation identifies one groundwater sample contaminated with manganese intercepting the storm water drainage pipeline within Drainage Basin 33. Well 586001 is located upgradient of the storm water drainage pipeline leading to Outfall 33. There were no detections in the downgradient well consistent with EFF024 COPCs; therefore, this pathway is considered incomplete.

4.16.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 33.

4.16.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 33 due to a lack of an upland terrestrial source identification.

4.17 Drainage Basin 34

Drainage Basin 34 encompasses approximately 36 acres within Zone E and Zone F in the central section of the CNC. Land cover within the basin consists of approximately 35% unpaved surfaces, 40% paved surfaces, and 25% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the 128 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 34.

Figure 4-17 illustrates the area encompassing Drainage Basin 34 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.17.1 Potential Source Areas

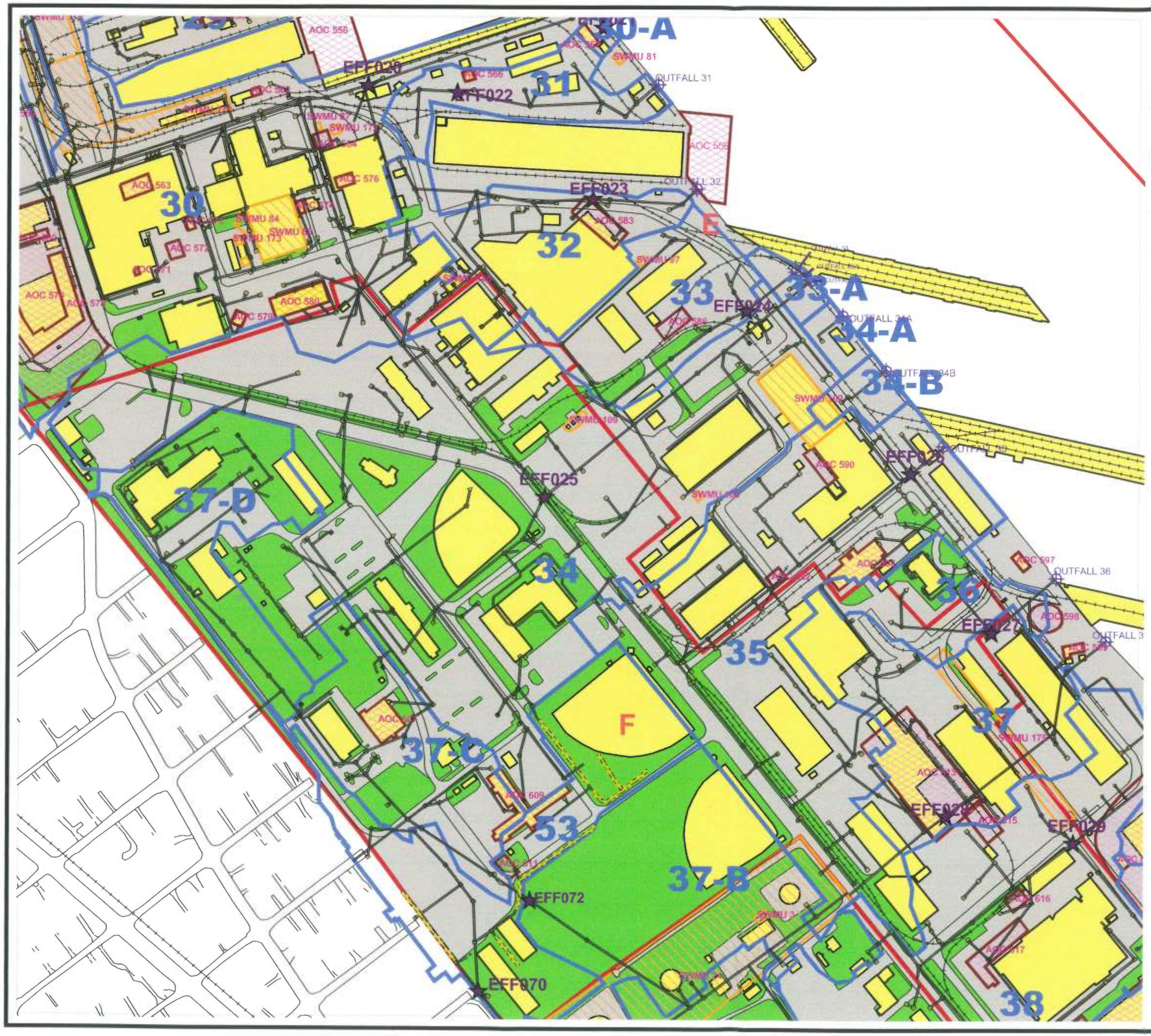
A review of the listing of sites found in Appendix A of the Part B Permit indicates there are five SWMUs/AOCs that are either partially or completely within the boundary of Drainage Basin 34. The sites are listed in Table 4.17.1 with the current status of each site. These sites include SWMU 100 (Satellite Accumulation Area), SWMU 102 (Mercury Spill Area), SWMU 109 (Abrasive Blast Media Storage Area), AOC 607 (Building 1189 Dry Cleaning), and AOC 609 (Building 1346 Gas Station). The majority of AOC 607 and AOC 609 are located in Drainage Basin 37; however, a few sample locations transcend the boundary of Drainage Basin 34.

Table 4.17.1
Drainage Basin 34 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 100	Building 218, Satellite Accumulation Area	Draft RFI Report; RFI Report Addendum, NFA
SWMU 102	Mercury Spill Area	Draft RFI Report
SWMU 109	Abrasive Blast Media Storage Area	Draft RFI Report; RFI Work Plan Addendum, RFI Report Addendum
AOC 607	Building 1189 Dry Cleaning	Draft RFI Report; RFI Work Plan Addendum; IM Phase I, II, III Work Plan
AOC 609	Building 1346 Gas Station	Draft RFI Report; RFI Report Addendum; NFA

4.17.1.1 SWMU 100
Site Description and History

SWMU 100, SAA 63, was a less-than-90 day accumulation area located adjacent to Building



N

300 0 300 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-17
Drainage Basin 34

November 2002 | Zone J Main Project.apr

218. The site is bound by Building 218 to the north and west, Building 1173 to the south, and an open asphalt area to the east. The operation dates of the SAA are not known. The unit consisted of closed 55-gallon drums accumulated on an asphalt-paved area. This unit had no containment structures.

Previous Investigations

A summary of investigative activities is presented in Table 4.17.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.17.2
Summary of SWMU 100 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 – 1997	Site investigation of soil and groundwater.	
	1995	***Round 1*** **Soil**: 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (100SB001 - 100SB003): cyanide, metals, pesticides, PCBs, SVOCs, VOCs, and organotins	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (100001): VOCs, SVOCs, pesticides, PCBs, organotins, metals, cyanide and general chemistry
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 1 shallow well (100001): organotins, metals, and general chemistry
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (100001): metals, and general chemistry
RFI (EnSafe)	1997	***Round 5*** **Soil:**	***Round 5*** **Groundwater:**

Table 4.17.2
Summary of SWMU 100 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		No Soil Samples Collected.	1 shallow well (100001): metals, and general chemistry

Nature and Extent of Contaminants

Approximately four sample locations associated with SWMU 100 were evaluated for the presence of contaminants between 1995 and 1997. All four sample locations are within the boundaries of Drainage Basin 34. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the satellite accumulation area and previous activities at the site.

4.17.1.2 SWMU 102
Site Description and History

SWMU 102 consisted of a mercury spill under the central portion of Building 79, which housed an ordnance shop from 1943 to 1966. SWMU 102 is bound by River Road to the north, an open asphalt area to the south, and Building 79 to the east and west.

Several incidents involving hazardous material spills, as well as cleanup activities, have been documented since 1976. The most noteworthy was the discovery of mercury beneath the floor inside the central portion of the building. Mercury was reportedly spilled and seeped under the floor, forming an approximately 10-foot diameter pool. The mercury release reportedly occurred in 1969. The level of cleanup conducted is not known.

Previous Investigations

A summary of RFI investigative activities is presented in Table 4.17.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.17.3
Summary of SWMU 102 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1997	Site investigation of soil and groundwater.	
	1996	***Round 1*** **Soil**: 9 surface borings (0 to 1 foot) 9 subsurface borings (3 to 5 feet) (102SB001-102SB009): SVOCs, VOCs, metals, pesticides, PCBs, cyanide, and organotins	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** 20 surface borings (0 to 1 foot) (102SB013 - 102SB033): mercury 19 subsurface borings (3 to 5 feet) (102SB013, 102SB015 - 102SB018, 102SB020 - 102SB025, 102SB027 – 102SB033): Mercury	***Round 2*** **Groundwater:** 1 shallow well (102001: metals, SVOCs, VOCs, pesticides, PCBs, cyanide, and general chemistry
RFI (EnSafe)	1996	***Round 3*** **Soil:** 12 surface borings (0 to 1 foot) (102SB034 – 102SB042): SVOCs, pesticides, PCBs, metals, and cyanide (102SB043 – 102SB045): pesticides, PCBs, metals, and cyanide 8 subsurface borings (3 to 5 feet) (102SB034 -102SB037, 102SB039 – 102SB042): SVOCs, pesticides, PCBs, metals, and cyanide	***Round 3*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 3*** **Soil:** 6 surface borings (0 to 1 foot) (102SB034 – 102SB037): VOCs (102SB041, 102SB046): VOCs, SVOCs, pesticides, PCBs, metals, and cyanide	***Round 3*** **Groundwater:** 1 shallow well (102001): SVOCs, organotins, metals, and general chemistry
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (102001): metals, and general chemistry
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (102001): metals, and general chemistry

Nature and Extent of Contaminants

Approximately 48 sample locations associated with SWMU 102 were evaluated for the presence of contaminants in 1996 and 1997. Of the 48 locations, approximately 11 are within the boundaries of Drainage Basin 34. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the mercury spill area and previous activities at the site. Of particular interest were detections of arsenic, lead, mercury, dieldrin, and BEQs in soil, and thallium in groundwater.

4.17.1.3 SWMU 109

Site Description and History

SWMU 109 (a CSI site) was the abrasive blast media storage area in Zone F. The site consisted of three hoppers identified as Buildings 1364, 1365, and 1393, used to store the abrasive blast media. Hoppers 1364 and 1365 began operation in 1949, while hopper 1393 was added in 1962. Particulate air emissions were permitted at the site in 1992. Materials released, stored, or disposed of at the site include aluminum oxide and "black beauty" blast media.

Previous Investigations

A summary of investigative activities is presented in Table 4.17.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone F RFI Report*.

Table 4.17.4
Summary of SWMU 109 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1997	Site investigation of soil and groundwater.	
	1996	***Round 1*** **Soil**: 6 surface borings (0 to 1 foot) 6 subsurface borings (3 to 5 feet) (109SB001 – 109SB006): metals, SVOCs, pesticides, PCBs (1 duplicate collected for same	***Round 1*** **Groundwater**: No Groundwater Samples Collected.

Table 4.17.4
Summary of SWMU 109 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		parameters) **Sediment**: 2 sediment samples (109M0001, 109M0003) metals, SVOCs, cyanide (1 duplicate collected for same parameters):	
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater**: 1 shallow well (109001): SVOCs, and metals
RFI (EnSafe)	1997	***Round 3*** **Soil:** 3 surface borings (0 to 1 foot) (109SB007 – 109SB009): Arsenic	***Round 3*** **Groundwater**: No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater**: 1 shallow well (109001): SVOCs, and metals
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater**: 1 shallow well (109001): SVOCs, and metals
RFI (EnSafe)	1997	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater**: 1 shallow well (109001): SVOCs, and metals
RFI (EnSafe)	1999	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater**: 1 shallow well (109002): VOCs, SVOCs, pesticides, PCBs, and metals
RFI (EnSafe)	1999	***Round8*** **Soil:** 3 surface borings (0 to 1 foot) (109SB001, 109SB004 – 109SB005): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and general chemistry (109SB010): metals	***Round 8*** **Groundwater**: No Groundwater Samples Collected.
CH2M-Jones	2001	***Round 9*** **Soil:** 6 surface borings (0 to 1 foot) (109SB011 – 109SB014): lead (GDLSB006 – GDLSB007): SVOCs, and Copper 4 subsurface borings (3 to 5 feet) (109SB011 – 109SB014): lead	***Round 9*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 21 sample locations associated with SWMU 109 were evaluated for the presence of contaminants between 1996 and 2001. All 21 sample locations are within the boundaries of Drainage Basin 34. Surface, subsurface, sediment, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the abrasive blast media storage area and previous activities at the site. Of particular interest were detections of arsenic, beryllium, and BEQs in soil.

4.17.1.4 AOC 607

Site Description and History

An RFI site, AOC 607 is the former dry-cleaning facility at Building 1189, which operated from 1942 to 1986. From 1986, the facility was used as a laundry, housing two industrial washers and dryers. While operating as a dry-cleaning establishment, the facility was classified as a minor emitter of total hydrocarbons. Materials released, stored, or disposed of at the site included perchlorethylene solvent.

Previous Investigations

A summary of investigative activities performed at AOC 607 is presented in Table 4.17.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone F RFI Report*.

Table 4.17.5
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations

Table 4.17.5
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (607SB001 – 607SB004): SVOCs, VOCs, metals	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** 6 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (607SB005): VOCs, metals (607SB006 – 607SB010): SVOCs, VOCs, metals	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 6 shallow wells (607001 - 607004, 607006, 607007): metals, SVOCs, and VOCs
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 8 shallow wells (607001 -607004, 607006, 607007, 607009): metals, SVOCs, and VOCs (607008): VOCs
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow wells (607008): VOCs
RFI (EnSafe)	1997	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 8 shallow wells (607001 - 607004, 607006, 607007 - 607009): VOCs, SVOCs, and metals
RFI (EnSafe)	1997	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 8 shallow wells (607001 - 607004, 607006, 607007 - 607009): VOCs, SVOCs, and metals

Table 4.17.5
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
EnSafe	1998	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** 2 shallow wells (607008 – 607009): VOCs, SVOCs, and metals
EnSafe	1998	***Round 9*** **Soil:** No Soil Samples Collected.	***Round 9*** **Groundwater:** 8 shallow wells (607001 – 607004, 607006 - 607009): VOCs, SVOCs, and metals
EnSafe	1998	***Round 10*** **Soil:** 7 surface borings (0 to 1 foot) (607SB011 – 607SB015, 607SB017, 607SB018): VOCs	***Round 10*** **Groundwater:** 8 shallow wells (607001 – 607004, 607006 – 607009): VOCs
EnSafe	1999	***Round 11*** **Soil:** No Soil Samples Collected.	***Round 11*** **Groundwater:** 16 shallow wells (607001 – 607004, 607006 – 607017): VOCs
EnSafe	1999	***Round 12*** **Soil:** No Soil Samples Collected.	***Round 12*** **Groundwater:** 16 shallow wells (607001 – 607004, 607006 – 607017): VOCs
EnSafe	1999	***Round 13*** **Soil:** No Soil Samples Collected.	***Round 13*** **Groundwater:** 16 shallow wells (607001 – 607004, 607006 – 607017): VOCs
EnSafe	1999	***Round 14*** **Soil:** No Soil Samples Collected.	***Round 14*** **Groundwater:** 8 shallow wells (607010 – 607017): VOCs
EnSafe	1999	***Round 15*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (607SB008, 607SB010, 607SB016): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and general chemistry	***Round 15*** **Groundwater:** 8 shallow wells (607001, 607003 – 607004, 607006 – 607008): VOCs (607002): VOCs, and lead (607009): VOCs, and metals
EnSafe	2000	***Round 16*** **Soil:** No Soil Samples Collected.	***Round 16*** **Groundwater:** 4 shallow wells (607001, 607003 – 607004, 607009): VOCs

Table 4.17.5
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CH2M-Jones	2001	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 7 shallow wells (607005, 607018, 607021 – 607024, 607026): VOCs
CH2M-Jones	2001	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 3 shallow wells (607002): metals (607005, 607026): VOCs
CH2M-Jones	2001	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (607P01 - 607P02): VOCs
CH2M-Jones	2001	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 18 shallow wells (607002 – 607004, 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs
CH2M-Jones	2001	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 6 shallow wells (607002, 607003, 607007, 607024, 607030 – 607031): VOCs
CH2M-Jones	2001	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 7 shallow wells (607002 - 607004, 607007, 607024, 607030 – 607031): VOCs
CH2M-Jones	2001	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 13 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607021, 607024 – 607025, 607027 - 607028, 607030 – 607031): VOCs
CH2M-Jones	2001	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** 19 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs

Table 4.17.5
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CH2M-Jones	2001	***Round 9*** **Soil:** No Soil Samples Collected.	***Round 9*** **Groundwater:** 19 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs
CH2M-Jones	2001	***Round 10*** **Soil:** No Soil Samples Collected.	***Round 10*** **Groundwater:** 19 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs
CH2M-Jones	2001	***Round 11*** **Soil:** No Soil Samples Collected.	***Round 11*** **Groundwater:** 19 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs
CH2M-Jones	2001	***Round 12*** **Soil:** No Soil Samples Collected.	***Round 12*** **Groundwater:** 19 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs

Nature and Extent of Contaminants

Approximately 45 sample locations associated with AOC 607 were evaluated for the presence of contaminants between 1996 and 2001. Of these 45, 2 sample locations are within the boundaries of Drainage Basin 34. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of vinyl chloride and aluminum in surface soil and tetrachloroethene, vinyl chloride, trichloroethene, arsenic, and trichloride in shallow groundwater. Based on analytical results, a CMS was recommended for shallow groundwater at AOC 607. CMS activities are currently ongoing.

4.17.1.5 AOC 609

Site Description and History

AOC 609 is the former gasoline station, automotive repair and maintenance shop at Building 1346, which was built in 1962. The focus of the RFI was the waste oil UST at Building 1346. Materials released, stored or disposed of at the site included gasoline, diesel fuel, motor/lubricating oils, degreasing solvents, antifreeze and various automotive products.

This site contained USTs which contained gasoline and diesel fuel. Three of the original nine steel USTs were found to be leaking in 1991 and were removed. They were replaced with fiberglass tanks in 1992. The 560-gallon steel waste oil UST on the west side of the building being assessed during RFI was removed in 1996. The tank received waste oil from floor drains in the maintenance garage, and was periodically emptied by suctioning to a waste oil truck.

Previous Investigations

A summary of investigative activities performed at AOC 609 is presented in Table 4.17.6, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone F RFI Report*.

Table 4.17.6
Summary of AOC 609 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1997	Site investigation of soil and groundwater.	
	1996	***Round 1*** **Soil:** 6 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (609SB001 – 609SB005): SVOCs, VOCs, and metals	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) (609SB003): pH, TOC, and cation exchange	***Round 2*** **Groundwater:** No Groundwater Samples Collected.

Table 4.17.6
Summary of AOC 609 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1999	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (609001 – 609002): SVOCs, VOCs, metals, pesticides, and PCBs
RFI (EnSafe)	1999	***Round 4*** **Soil:** 8 surface borings (0 to 1 foot) 8 subsurface borings (3 to 5 feet) (609SB007 – 609SB012): metals (609SB001 – 609SB002): SVOCs, VOCs, metals, pesticides, PCBs, cyanide, and general chemistry	***Round 4*** **Groundwater:** 2 shallow wells (609001 – 609002): VOCs and metals

Nature and Extent of Contaminants

Approximately 16 sample locations associated with AOC 609 were evaluated for the presence of contaminants between 1996 and 1999. Of these 16, one sample location is within the boundaries of Drainage Basin 34. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of arsenic, beryllium, BEQs, antimony, and manganese in surface soil, and benzene, arsenic, toluene, and 4-methyl phenol in shallow groundwater.

4.17.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 34/5 on July 15, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 34 into the Cooper River. Analytical detections for sample EFF025 are presented in Table 4.17.7.

Table 4.17.7
Storm Water Effluent Sampling Results
Drainage Basin 34

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Chronic Saltwater Screening Value	Potential COPC
34	34/5	EFF025	Aluminum	1,100	3,277	NL	No
			Barium	8.10	60.31	NL	No
			Calcium*	3,400	53,455	NL	No
			Chromium	4.00	13	50	No
			Copper	18	41.98	2.90	No
			Iron	1,900	4,134	NL	No
			Lead	28	33.63	8.50	No
			Magnesium*	1,800	49,255	NL	No
			Manganese	**80**	**74.52**	**NL**	**Yes**
			Potassium*	1,300	23,678	NL	No
			Sodium*	14,000	395,333	NL	No
			Tin	**3.80**	**NL**	**NL**	**Yes**
			Vanadium	5.80	15.59	NL	No
			Zinc	100	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.17.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 34. Table 4.17.8 summarizes the migration pathway scenarios.

Table 4.17.8
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 34

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No

Table 4.17.8
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 34

Scenario	Pathway Description	Is Pathway Complete?
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.17.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS, employees discharged oily wastewater into the trenches around Building 97 which led to the storm water drains. A report stated that on August 3, 1992 a hydraulic oil spill of ~ 75 to 90 gallons occurred at a hydraulic pump at Building 218 and flowed down a storm drain. Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF025 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.17.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 128 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone E background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source of manganese or tin in the storm sewer system.

4.17.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were

identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 34 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with manganese or tin intercepting the storm water drainage pipeline within Drainage Basin 34.

4.17.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 34.

4.17.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 34 due to a lack of an upland terrestrial source identification.

4.18 Drainage Basin 35

Drainage Basin 35 encompasses approximately 19 acres within Zone E in the central section of the CNC. Land cover within the basin consists of approximately 5% unpaved surfaces, 60% paved

surfaces, and 35% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the 94 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 35.

Figure 4-18 illustrates the area encompassing Drainage Basin 35 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.18.1 Potential Source Areas

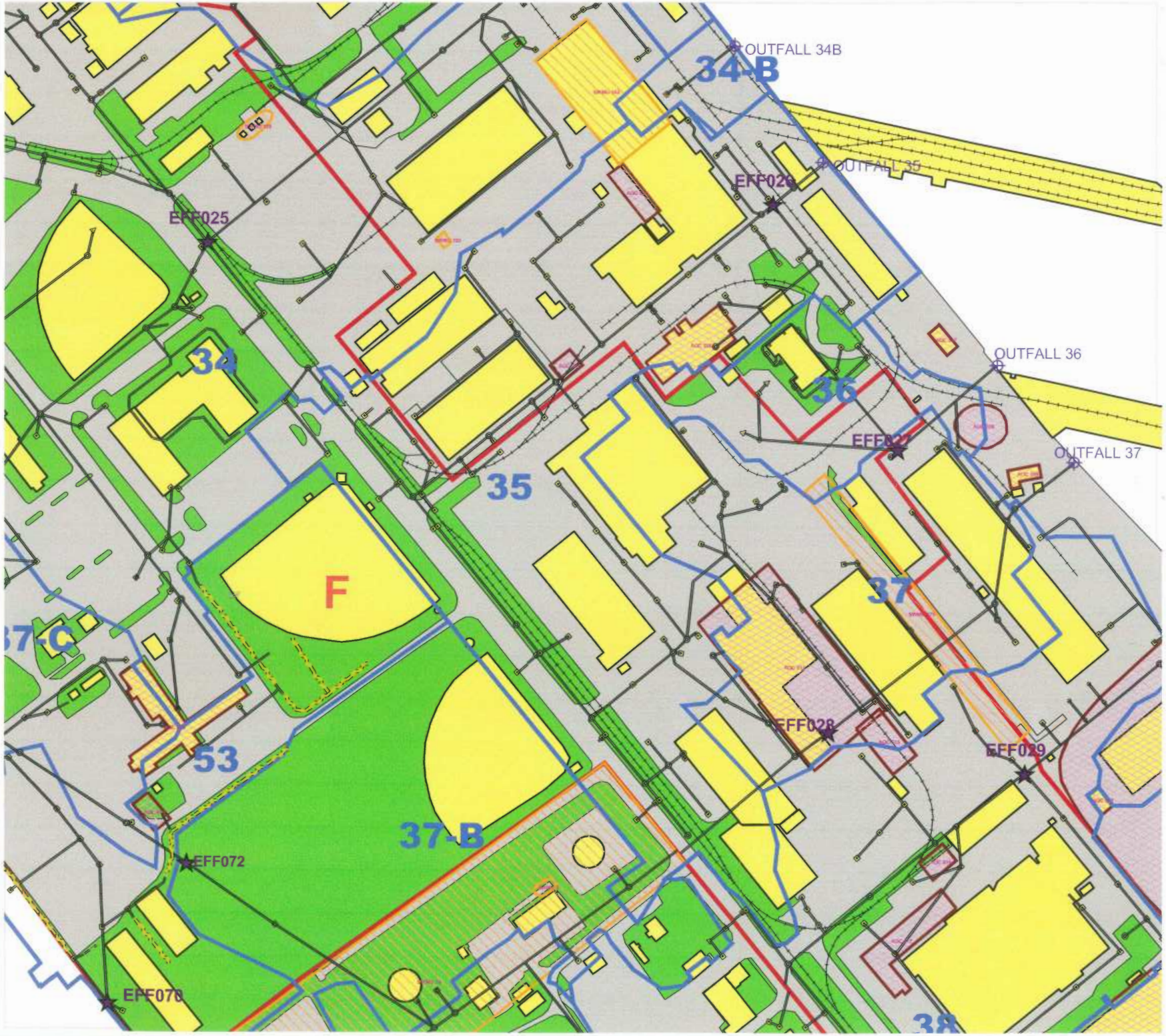
A review of the listing of sites found in Appendix A of the Part B Permit indicates there are six SWMUs/AOCs that are either partially or completely within the boundary of Drainage Basin 35. The sites are listed in Table 4.18.1 with the current status of each site. Four of the sites were included in the Zone J data evaluation. The sites that have sample locations within Drainage Basin 35 include SWMU 102 (Mercury Spill Area), AOC 590 (Alley between Buildings 1760 and 79), AOC 596 (Former Torpedo Storage), and AOC 613 (Old Locomotive Repair Shop).

Table 4.18.1
Drainage Basin 35 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 24	Waste Oil Reclamation Facility	Draft RFI Report; IM complete; RFI Report Addendum
SWMU 102	Mercury Spill Area	Draft RFI Report
AOC 590	Alley Between Buildings 1760 and 79	Draft RFI Report
AOC 592	Former Asbestos Shredding Shelter	Draft RFI Report
AOC 596	Former Torpedo Storage	Draft RFI Report
AOC 613	old locomotive repair shop	Draft RFI Report; RFI Work Plan Addendum; RFI Report Addendum; CMS Work Plan

4.18.1.1 SWMU 102
Site Description and History

SWMU 102 is a mercury spill under the central portion of Building 79 which housed an ordnance shop from 1943 to 1966. SWMU 102 is bound by River Road to the north, an open asphalt area to the south, and Building 79 to the east and west.



200 0 200 Feet

N

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-18
Drainage Basin 35

November 2002 | Zone J Main Project.apr

Previous Investigations

No environmental media data collected from previous investigations have been found for this site. However, several incidents involving hazardous material spills, as well as cleanup activities, have been documented since 1976. The most noteworthy was the discovery of mercury beneath the floor inside the central portion of the building. Mercury was reportedly spilled and seeped under the floor, forming an approximately 10-foot diameter pool. The mercury release reportedly occurred in 1969. The level of cleanup conducted is not known. A summary of RFI investigative activities is presented in Table 4.18.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.18.2
Summary of SWMU 102 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1997	Site investigation of soil and groundwater.	
		Round 1 **Soil**: 9 surface borings (0 to 1 foot) 9 subsurface borings (3 to 5 feet) (102SB001-102SB009): SVOCs, VOCs, metals, pesticides, PCBs, cyanide 1 surface soil duplicate: same parameters as above	***Round 1*** **Groundwater:** 1 shallow well (102001): metals, SVOCs, VOCs, pesticides, PCBs, cyanide.
RFI (EnSafe)	1996 - 1997	***Round 2*** **Soil:** 9 surface borings (0 to 1 foot) 9 subsurface borings (3 to 5 feet) (102SB013 - 102SB033): Mercury	***Round 2*** **Groundwater:** 1 shallow well (102001): metals, organotins, SVOCs,.
RFI (EnSafe)	1996 - 1997	***Round 3*** **Soil:** 10 surface borings (0 to 1 foot) 10 subsurface borings (3 to 5 feet) (102SB034 – 102SB037): SVOCs, VOCs, metals, pesticides, PCBs, cyanide (102SB038 – 102SB43): SVOCs, metals, pesticides, PCBs, cyanide	***Round 3*** **Groundwater:** 1 shallow well (102001): metals.
RFI (EnSafe)	1996 - 1997	***Round 4*** **Soil:** 3 surface borings (0 to 1 foot)	***Round 4*** **Groundwater:** 1 shallow well

Table 4.18.2
Summary of SWMU 102 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
		3 subsurface borings (3 to 5 feet) (102001): metals. (102SB044 – 102SB046): metals, cyanide, pesticides, PCB, SVOCs, VOCs

Nature and Extent of Contaminants

Forty-six sample locations associated with SWMU 102 were evaluated for the presence of contaminants in 1996 and 1997. Of the 46 locations, 31 are within the boundaries of Drainage Basin 35. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the mercury spill area and previous activities at the site. Of particular interest were detections of arsenic, lead, mercury, dieldrin, and BEQs in soil, and thallium in groundwater.

4.18.1.2 AOC 590

Site Description and History

AOC 590 is the alley between Buildings 1760 and 79. Reportedly, this alley is the site of past releases of acetone and cutting oil. The site is bound by Building 79 to the north, an open paved area to the south, Ninth Street to the east, and Eighth Street to the west. No information was found regarding the exact locations, volumes, or duration of the discharged wastes. Currently, the alley is paved with asphalt.

Previous Investigations

The RFI is the only investigation that has been conducted for AOC 590. A summary of investigative activities is presented in Table 4.18.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.18.3
Summary of AOC 590 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1997	Site investigation of soil, sediment, and groundwater.	
		Round 1 **Soil**: 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (590SB001 – 590SB005): VOCs, SVOCs, metals	***Round 1*** **Groundwater**: 1 shallow well (590001): metals, SVOCs, VOCs.
		Sediment: 1 sediment sample (590M0001): metals, SVOCs, VOCs.	
RFI (EnSafe)	1996 – 1997	***Round 2*** **Soil**: 1 surface boring (0 to 1 foot) (590SB006): SVOCs, metals	***Round 2*** **Groundwater:** 1 shallow well (590001): metals, SVOCs, VOCs
RFI (EnSafe)	1996 – 1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 1 shallow well (590001): metals, SVOCs, VOCs.
RFI (EnSafe)	1996 – 1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (590001): metals, SVOCs, VOCs.

Nature and Extent of Contaminants

Seven sample locations associated with SWMU 590 were evaluated for the presence of contaminants in 1996 and 1997. Of the seven locations, six are within the boundaries of Drainage Basin 35. Surface, subsurface, sediment, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the alley between Buildings 1760 and 79 and previous activities at the site. Of particular interest were detections of BEQs in soil and beryllium and thallium in groundwater.

4.18.1.3 AOC 596

Site Description and History

AOC 596 is the site of a former torpedo storage area located in Building 101. Building 101 was built in 1919 and was used to store torpedoes until 1943. AOC 596 is bound by an open paved area to the north, Building 241 to the south, an open grass and paved area to the east, and Ninth Street to the west. From 1943 to 1946, the building housed a machine shop. In 1946, the building was converted into a storehouse for diesel parts and in 1947 it was used as a storage house for a

galvanizing plant. From 1981 to 1995, it was used to store radioactive-contaminated material.

Previous Investigations

The RFI is the only investigation that has been conducted for AOC 596. A summary of investigative activities is presented in Table 4.18.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.18.4
Summary of AOC 596 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1997	Site investigation of soil and groundwater.	
		Round 1 **Soil**: 11 surface borings (0 to 1 foot) 11 subsurface borings (3 to 5 feet) (596SB001-596SB007,596SB009 – 596SB012): VOCs, SVOCs, metals	***Round 1*** **Groundwater**: 3 shallow wells (596001 - 596003): metals, SVOCs, VOCs.
RFI (EnSafe)	1996 - 1997	***Round 2*** **Soil**: 1 surface boring (0 to 1 foot) 1 subsurface boring (3 to 5 feet) (596SB013): VOCs, SVOCs, metals	***Round 2*** **Groundwater**: 3 shallow wells (596001 - 596003): metals, and Dioxins.
RFI (EnSafe)	1996 - 1997	***Round 3*** **Soil:** No Soil Samples Collected	***Round 3*** **Groundwater**: 3 shallow wells (596001 - 596003): metals.
RFI (EnSafe)	1996 - 1997	***Round 4*** **Soil:** No Soil Samples Collected	***Round 4*** **Groundwater**: 3 shallow wells (596001 - 596003): metals.

Nature and Extent of Contaminants

Fifteen sample locations associated with AOC 596 were evaluated for the presence of contaminants in 1996 and 1997. Of the 15 locations, nine are within the boundaries of Drainage Basin 35. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the temporary torpedo storage and previous activities at the site. Of particular interest were detections of arsenic,

BEQs, Isophorone, and N-nitro-di-n-propylamine in soil, and arsenic, lead, and thallium in groundwater. Surface and subsurface soil and shallow and deep groundwater were recommended for CMS.

4.18.1.4 AOC 613

Site Description and History

AOC 613 (an RFI site) is located at the former Building 1169, a former locomotive and crane repair facility which operated from the 1930s until 1985, at which time the building was demolished. Maintenance activities included changing oil, repairing hydraulic systems and overhauling equipment. Materials released, stored, or disposed of at the site included oil, grease, diesel fuel, and cleaning solvents. Numerous spills were reported, some to the storm water drainage system. In addition, a UST at the site allegedly contained waste oil and other waste liquids. Documentation of an apparent removal of this UST was unavailable. Building 242, built in 1987, occupies a portion of the site area.

Previous Investigations

A summary of investigative activities performed at AOC 613 is presented in Table 4.18.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone F RFI Report*.

Table 4.18.5
Summary of AOC 613 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1999	Site investigation of soil and groundwater.	
	1996	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 4 shallow wells (613001, 613003, 613004, and 613005): SVOCs, VOCs, and metals

Table 4.18.5
Summary of AOC 613 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 4 shallow wells (613001, 613003, 613004, and 613005): SVOCs, VOCs, and metals
RFI (EnSafe)	1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 4 shallow wells (613001, 613003, 613004, and 613005): SVOCs, VOCs, and metals
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 4 shallow wells (613001, 613003, 613004, and 613005): SVOCs, VOCs, and metals
RFI (EnSafe)	1998	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (613006): SVOCs, VOCs, and metals
RFI (EnSafe)	1999	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 1 shallow well (613006): SVOCs, VOCs, metals, cyanide, pesticides, and PCBs
RFI (EnSafe)	1999	***Round 7*** **Soil:** 19 surface borings (0 to 1 foot) 19 subsurface borings (3 to 5 feet) (613SB001 through 613SB014, 613SB016 and 613SB016): SVOCs and metals (613SB019 through 613SB022): metals	***Round 7*** **Groundwater:** 2 shallow wells (613001): VOCs (613006): SVOCs, VOCs, and metals
RFI (EnSafe)	1999	***Round 8*** **Soil:** 10 surface borings (0 to 1 foot) 9 subsurface borings (3 to 5 feet) (613SB021 through 613SB022): SVOCs (613SB023 through 613SB026): SVOCs and metals	***Round 8*** **Groundwater:** 2 shallow wells (613007): SVOCs, VOCs, and metals (613008): VOCs

Table 4.18.5
Summary of AOC 613 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1999	***Round 9*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (613SB029 through 613SB030): SVOCs and metals	***Round 9*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 38 sample locations associated with AOC 613 were evaluated for the presence of contaminants between 1996 and 1999. Of these 38, approximately nine sample locations are within the boundaries of Drainage Basin 37. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of arsenic, beryllium, BEQs, and aluminum in soil, and arsenic, benzene, beryllium, bis(2-ethylhexyl)phthalate, acenapthene, fluorene, 2-methylnapthalene, and phenanthrene.

4.18.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 35/1 on June 18, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 35 into the Cooper River. Analytical detections for sample EFF026 are presented in Table 4.18.6.

Table 4.18.6
Storm Water Effluent Sampling Results
Drainage Basin 35

					Screening Value(μg/L)		
Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Reference Concentration	Chronic Saltwater Screening Value	Potential COPC
35	35/1	EFF026	Aluminum	430	3,277	NL	No

Table 4.18.6
Storm Water Effluent Sampling Results
Drainage Basin 35

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value(μg/L) Reference Concentration	Chronic Saltwater Screening Value	Potential COPC
			Barium	4.80	60.31	NL	No
			Calcium*	5,600	53,455	NL	No
			Chromium	1.80	13	50	No
			Copper	9.20	41.98	2.90	No
			Iron	560	4,134	NL	No
			Lead	9.50	33.63	8.50	No
			Magnesium*	690	49,255	NL	No
			Manganese	15	74.52	NL	No
			Potassium*	570	23,678	NL	No
			Silver	0.70	2.34	NL	No
			Sodium*	3,700	395,333	NL	No
			Vanadium	3.00	15.59	NL	No
			Zinc	64	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.18.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 35. The Zone J data evaluation resulted in three possible outcomes based on the available data present for Drainage Basin 35. Table 4.18.7 summarizes the migration pathway scenarios.

Table 4.18.7
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 35

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No

Table 4.18.7
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 35

Scenario	Pathway Description	Is Pathway Complete?
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.18.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. The EBS states that according to a 1989 Environmental Incident Report stated that approximately 67,500 gallons of dilute chemical waste (cleaning solution) was discharged on Pier F (facility 317E) and into the Cooper River via a broken sanitary sewer pipe. Spill contents included ammonium hydroxide, hydrazine, chromium, cooper, lead, nickel, and zinc. The EBS for building 241 states that there is a history of oil, grease, diesel fuel, and chemical cleaning solutions being spilled and entering the storm sewer system around the building.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF026 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

There were no potential storm water effluent COPCs identified for Drainage Basin 32 that require further characterization; therefore contaminant migration pathway scenarios 1b through 1d do not require further evaluation.

4.19 Drainage Basin 36

Drainage Basin 36 encompasses approximately 3 acres within Zone E in the central section of the CNC along the Cooper River. Land cover within the drainage basin consists of approximately 70% paved surfaces, 20% unpaved surfaces (i.e., mostly grass), and 10% buildings. Most storm water runoff within the drainage basin is directed to a storm sewer pipeline with 16 catch basins that discharge to the Cooper River via Outfall 36/1.

Figure 4-19 illustrates the area encompassing Drainage Basin 36 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.19.1 Potential Source Areas

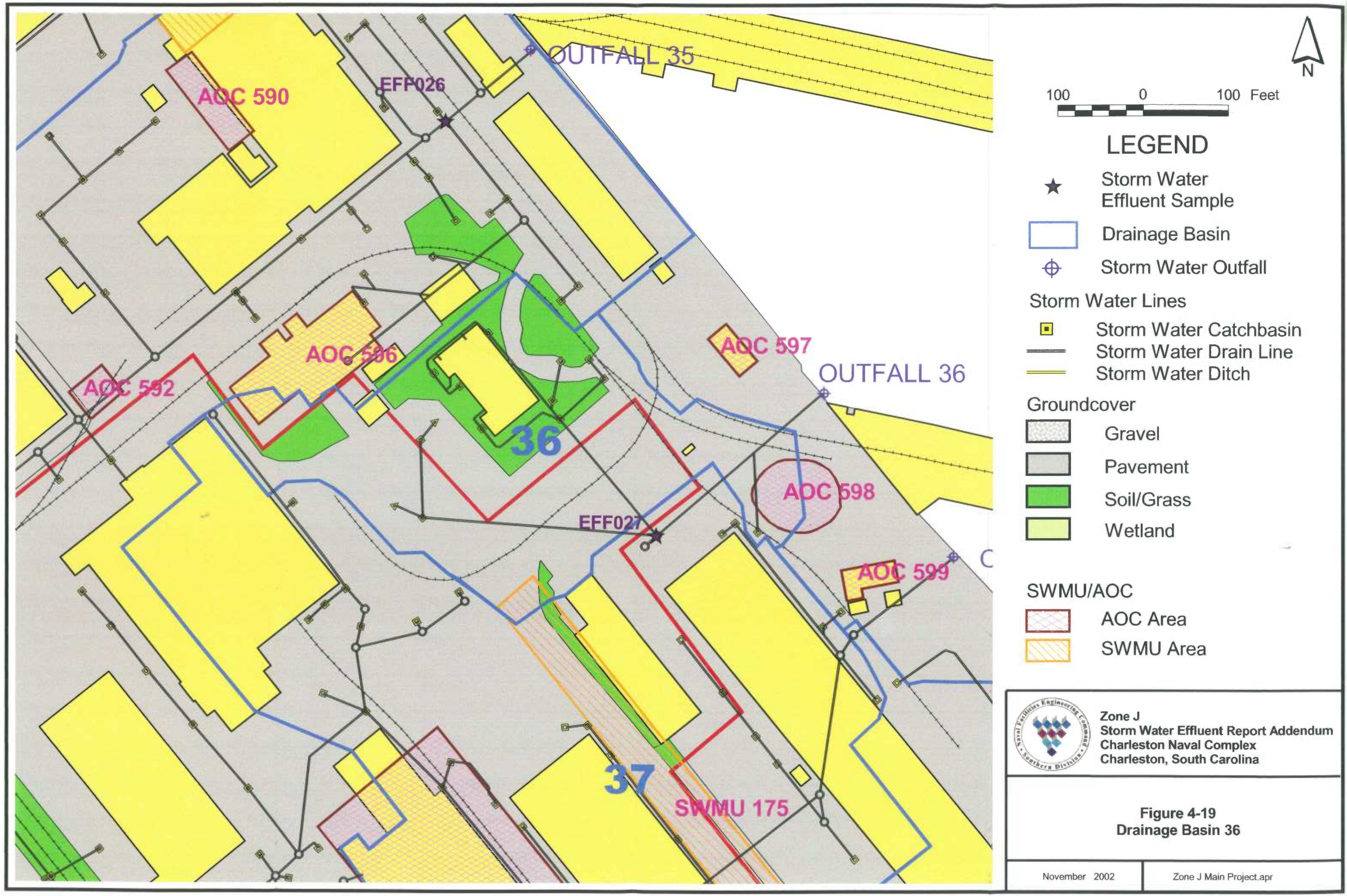
A review of the listing of sites in Appendix A of the Part B permit indicates that there are three SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 36. The sites are listed in Table 4.19.1, along with their current status. Two of the sites were included in the Zone J evaluation. The sites that have sample locations within Drainage Basin 36 include AOC 596 (Former Torpedo Storage) and AOC 598 (Sonar Dome Area). For this basin assessment, note that the eastern section of AOC 598 transcends the eastern boundary of Drainage Basin 36; however, the majority of AOC 598 resides in Drainage Basin 36. Also note that the majority of AOC 596 resides in DB 45, and that only the southwest corner of AOC 596 is contained within DB 36.

Table 4.19.1
Drainage Basin 36 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 175	Crane Painting Area, South of Building 1277	Draft RFI Report; RFI Work Plan Addendum; RFI Report Addendum; CMS Work Plan
AOC 596	Former Torpedo Storage	Draft RFI Report
AOC 598	Sonar Dome Area	Draft RFI Report

4.19.1.1 AOC 596
Site Description and History

AOC 596 is the Former Torpedo Storage, Building 101 (Solvents, Degreasers, Explosives, Propellants, and Petroleum Hydrocarbons). This site was used for storing torpedoes until 1943 and


OUTFALL 35
EFF026
AOC 590
AOC 596
AOC 592
AOC 597
OUTFALL 36
36
AOC 598
EFF027
AOC 599
37
SWMU 175
N
100 0 100 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-19
Drainage Basin 36
November 2002
Zone J Main Project.apr

for various purposes including a machine shop, a storehouse, and for storing radioactive-contaminated materials.

Previous Investigations

A summary of investigative activities performed at AOC 596 is presented in Table 4.19.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone E RFI Report*.

Table 4.19.2
Summary of AOC 596 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation	
	1995	***Round 1*** **Soil:** 12 surface borings (0 to 1 foot) 12 subsurface borings (3 to 5 feet) (596SB001 – 596SB012): metals, SVOCs, and VOCs (no VOCs at 596SB002)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) 1 subsurface boring (3 to 5 feet) (596SB013 - 596SB013): metals, SVOCs, PCBs, pesticides, and, cyanide.	***Round 2*** **Groundwater:** 4 shallow wells (596001 – 596004): VOCs, SVOCs, metals, chloride, sulfate, and TDS
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 4 shallow wells (596001 – 596004): Dioxin, metals, chloride, sulfate, and TDS
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 4 shallow wells (596001 – 596004): metals, chloride, sulfate, and TDS
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 4 shallow wells (596001 – 596004): metals, chloride, sulfate, and TDS

Nature and Extent of Contaminants

Approximately 17 sample locations associated with AOC 596 were evaluated for the presence of contaminants between 1995 and 1997. Of these 17 samples, approximately 5 locations are within the boundaries of Drainage Basin 36. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to historic coal pile storage at the site. Of particular interest were detections of arsenic, BEQs, Isophorone, N-Nitro-di-n-propylamine in soil; and arsenic, thallium, and lead in groundwater.

4.19.1.2 AOC 598

Site Description and History

AOC 598 is the Sonar Dome Area, at the end of Pier J (Paints, Solvents, Adhesives, Blasting Grit). This site was used to clean and repaint sonar domes and to remove adhesives.

Previous Investigations

A summary of investigative activities performed at AOC 598 is presented in Table 4.19.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone E RFI Report*.

Table 4.19.3
Summary of AOC 598 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations

Table 4.19.3
Summary of AOC 598 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site soil and groundwater investigation.	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (598SB001 – 598SB004): VOCs, SVOCs, metals, pesticides, PCBs, and cyanide (exception- 598SB001 not analyzed for cyanide)	***Round 1*** **Groundwater:** 1 shallow well (598001): VOCs, SVOCs, metals, chloride, sulfate, TDS, cyanide, pesticides, and PCBs
	1996	***Round 2*** **Soil:** 2 surface borings (0 to 1 foot) 1 subsurface borings (3 to 5 feet) (598SB005 – 598SB006): SVOCs and metals	***Round 2*** **Groundwater:** 1 shallow well (598001): SVOCs, metals, chloride, sulfate, TDS,
	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 1 shallow well (598001): metals, PCBs, pesticides, chloride, sulfate, and TDS
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (598001): metals, PCBs, pesticides, chloride, sulfate, and TDS

Nature and Extent of Contaminants

Approximately 15 sample locations associated with AOC 598 were evaluated for the presence of contaminants between 1995 and 1997. Of these 15, approximately three locations are within the boundaries of Drainage Basin 36. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs and lead in soil, and detections of thallium in groundwater.

4.19.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 36 into the Cooper River. A sample was collected at

manhole 36/1 on June 22, 2002. Analytical detections for sample EFF027 are presented in Table 4.19.4.

Table 4.19.4
Storm Water Effluent Sampling Results
Drainage Basin 36

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
36	36/1	EFF027	Aluminum	49	3,277	NL	No
			Barium	6.00	60.31	NL	No
			Calcium*	2,200	53,455	NL	No
			Copper	20	41.98	2.90	No
			Iron	54	4,134	NL	No
			Magnesium*	170	49,255	NL	No
			Manganese	2.40	74.52	NL	No
			Potassium*	320	23,678	NL	No
			Sodium*	1,300	395,333	NL	No
			Vanadium	1.30	15.59	NL	No
			Zinc	34	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.19.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 36. The Zone J data evaluation resulted in three possible outcomes based on the available data present for Drainage Basin 36. Table 4.19.5 summarizes the migration pathway scenarios.

Table 4.19.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 36

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.19.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS for Facility 317F (Pier J) a 35 gallons diesel fuel spill occurred in November 1984 with spill releasing to the Cooper River. The EBS for building 241 states that there is a history of oil, grease, diesel fuel, and chemical cleaning solutions being spilled and entering the storm sewer system around the building.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF027 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

There were no potential storm water effluent COPCs identified for Drainage Basin 32 that require further characterization; therefore contaminant migration pathway scenarios 1b through 1d do not require further evaluation.

4.20 Drainage Basin 37

Drainage Basin 37 encompasses approximately 42.4 acres within Zones E, F, and G, located near the central section of the CNC. Drainage Basin 37 has been subdivided into five sections, or smaller

drainage basins: DB 37, DB 37A, DB 37B, DB 37C, and DB 37D and will be referred to as the Combined Drainage Basin 37. Land cover within the drainage basin consists of approximately 49% paved surfaces, 35% unpaved surfaces (i.e., mostly grass), and 16% building foundations. Storm water runoff within the basin is directed to 135 catch basins discharging to the Cooper River via Outfall 37.

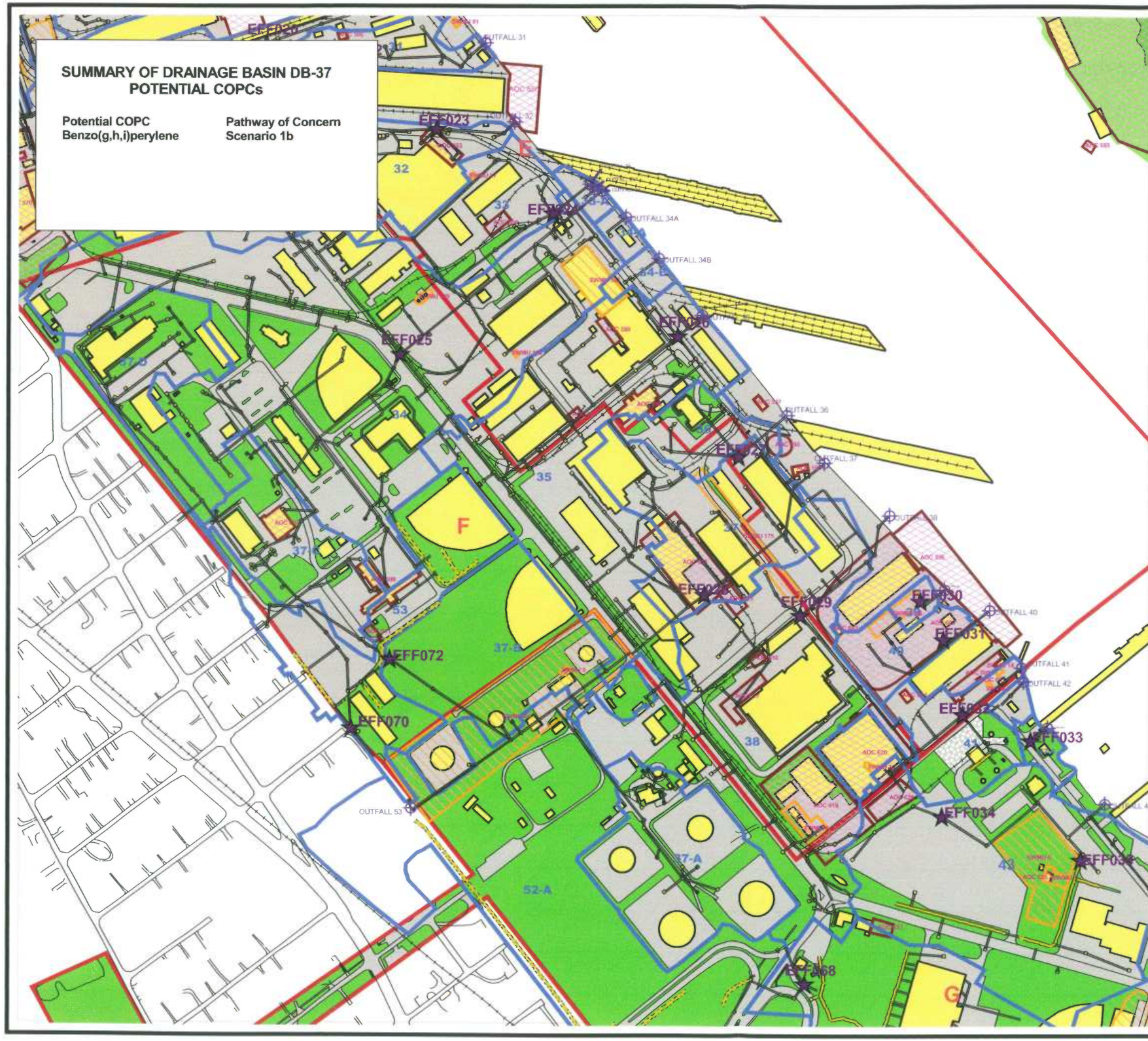
Figure 4-20 illustrates the area encompassing the Combined Drainage Basin 37 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.20.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there are seven SWMUs/AOCs that are partly or completely within the boundary of the Combined Drainage Basin 37. The sites are listed in Table 4.20.1, along with their current status. Six of the sites were included in the Zone J evaluation. The sites that have sample locations within Combined Drainage Basin 36 include SWMU 3 (pesticide mixing area), SWMU 24 (waste oil reclamation facility), SWMU 504 (railroad system), AOC 607 (building 1189 dry cleaning), AOC 609 (building 1346 gas station), AOC 611 (grease rack and hobby shop), and AOC 613 (old locomotive repair shop. AOC 607 is completely within DB 37-C. The southeast boundary of AOC 609 transcends the boundary of Combined Drainage Basin 37-C along the southeast side where it extends into Drainage Basins 53 and 34. AOC 611 is within DB 37-B. The majority of AOC 613 is within DB 37; however, AOC 613 transcends the northwestern boundary of DB 37 and extends into DB 35.

Table 4.20.1
Combined Drainage Basin 37 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 3	Pesticide Mixing Area	Draft RFI Report; IM Work Plan Phase I, II, III
SWMU 24	Waste Oil Reclamation Facility	Draft RFI Report; IM complete; RFI Report Addendum
SWMU 175	Crane Painting Area, South of Building 1277	Draft RFI Report; RFI Work Plan Addendum; RFI Report Addendum
AOC 607	Building 1189 Dry Cleaning	Draft RFI Report; RFI Work Plan Addendum, IM Work Plan Phase I and II
AOC 609	Building 1346 Gas Station	Draft RFI Report; RFI Report Addendum, NFA



N

400 0 400 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Naval Facilities Engineering Command Southern Division

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-20
Drainage Basin 37

January 2003	Zone J Main Project.apr

Table 4.20.1
Combined Drainage Basin 37 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 611	Grease Rack and Hobby Shop	Draft RFI Report; IM complete; RFI Report Addendum
AOC 613	Old Locomotive Repair Shop	Draft RFI Report; RFI Work Plan Addendum; RFI Report Addendum; CMS Work Plan
AOC 615	Old Chain Locker, Building 255 Area	Draft RFI Report; RFI Work Plan Addendum; RFI Report Addendum; CMS Work Plan

4.20.1.1 SWMU 3
Site Description and History

SWMU 3 is an approximately 50 by 30 foot area where the former Building 42-A was located. The building was a shed where pesticides were mixed prior to 1971. Equipment for spraying and mixing pesticides was reportedly rinsed on the ground outside, with the rinsate allowed to infiltrate the soil. During the 1982 Confirmation Study (Geraghty and Miller, 1982), a portion of the area surrounding the slab for Building 42-A was also noted to be devoid of vegetation. This once bare area is now covered with grass. The northwest wall of Building 249 was constructed later over a portion of the area concern. SWMU 3 is located adjacent to SWMU 24 in the western portion of Zone G.

An interim stabilization measure (IMS), completed at SWMU 3 by the Navy DET in 1998, was performed to remove approximately 22 cubic yards of pesticide-contaminated soil and properly abandon well 003GW003. Confirmation samples were collected from eight locations.

Previous Investigations

A summary of investigative activities performed at SWMU 3 is presented in Table 4.20.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone G RCRA Facility Investigation Report* (EnSafe, 1998) and *Draft Zone G RCRA Facility Investigation Addendum Report* (EnSafe, 1999).

Table 4.20.2
Summary of SWMU 3 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/ Samples/Locations	
RFI (EnSafe)	1996 -1999	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 10 surface borings (0 to 1 foot) 9 subsurface borings (3 to 5 feet) (003SB001): cyanide, metals, pesticide/PCBs, SVOCs, and OP pesticides (003SB002 and 003SB003): cyanide, metals, pesticides, PCBs, and OP pesticides (003SB004 – 003SB010): metals, pesticides, PCBs, and OP pesticides (1 duplicate collected for herbicides, pesticides, PCBs, SVOCs, VOCs, cyanide, hexavalent chromium, dioxins, metals, and OP pesticides)	***Round 1*** **Groundwater:** 3 shallow wells (003001 – 003003): herbicides, metals, OP pesticides, and pesticides, PCBs (1 duplicate collected for herbicides, pesticides, PCBs, SVOCs, VOCs, cyanide, hexavalent chromium, dioxins, metals, and OP pesticides)
RFI (EnSafe)	1996 - 1999	***Round 2*** **Soil:** 9 surface borings (0 to 1 foot) 10 subsurface borings (3 to 5 feet) (003SB011 – 003SB013): pesticides, PCBs (003SB0014): SPLP pesticide/PCBs and TOC (003SB0015 – 003SB020): pesticides	***Round 2*** **Groundwater:** 3 shallow wells (003001 – 003003): metals and pesticides (1 duplicate collected for same parameters)
RFI (EnSafe)	1996 - 1999	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 3 shallow wells (003001 – 003003): metals and pesticides (1 duplicate collected for same parameters)
RFI (EnSafe)	1996 - 1999	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 3 shallow wells (003001 – 003003): metals and pesticides (1 duplicate collected for the same parameters)
RFI (EnSafe)	1996 - 1999	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 3 shallow wells (003001 – 003003): metals, SVOCs, and VOCs (1 duplicate collected for the same parameters)

Table 4.20.2
Summary of SWMU 3 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/ Samples/Locations	
CH2M-Jones	2001-2002	***Round 1*** **Soil:** 16 surface soil borings (0 to 1 foot) (003SB021: VOCs, pesticides, and PCBs (033SB022 – 003SB036): VOCs, and pesticides 16 subsurface soil borings (3 to 5 feet) (003SB021: VOCs, pesticides, and PCBs (033SB022 – 003SB036): VOCs, and pesticides	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
CH2M-Jones	2001-2002	***Round 2*** **Soil:** 14 surface soil borings (0 to 1 foot) (003SB068 – 003SB081); pesticides 17 subsurface soil borings (3 to 5 feet) (003SB068 – 003SB084): pesticides	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
CH2M-Jones	2001-2002	***Round 3*** **Soil:** 6 surface soil borings (0 to 1 foot) (003SB085 – 003SB086, 003SB088 – 003SB091): pesticides 6 subsurface soil borings (3 to 5 feet) (003SB087 – 003SB092): pesticides	***Round 3*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contamination

Approximately 60 sample locations associated with SWMU 3 were evaluated for the presence of contaminants between 1996 and 2002. Of these 60, 29 sample locations are within the boundaries of Combined Drainage Basin 37. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contaminants at SWMU 3. Of particular interest were detections of Aroclor-1248, alpha-chlordane and gamma-chlordane in surface soil and beryllium, thallium, aluminum, vanadium, and chromium in shallow groundwater.

4.20.1.2 SWMU 24

Site Description and History

SWMU 24, the waste oil reclamation facility for the CNC, consists of tanks 39-A and 39-D. This area is located south of Hobson Avenue and east of Wood Street. SWMU 24 was originally investigated under the petroleum program as part of the FDS but was returned to the RCRA program

to assess inorganics detected in the area groundwater. Tanks 39-A and 39-D operated as waste oil settling tanks. Waste oil containing water and presumably other impurities was delivered to these tanks via the pipeline system. The tanks were used both to separate and store the water and oil phases. The wastewater was subsequently discharged to the sanitary sewer system.

Previous Investigation

A summary of investigative activities performed at SWMU 24 is presented in Table 4.20.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone G RCRA Facility Investigation Report* and *Draft Zone G RCRA Facility Investigation Addendum Report*.

Table 4.20.3
Summary of SWMU 24 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/ Samples/Locations	
RFI (EnSafe)	1996 - 1998	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) (FDSSH024 and FDSSH026): metals, pesticides, PCBs, SVOCs, VOCs, cyanide, TPH-diesel range organics (-DRO), and TPH-gasoline range organics (-GRO) (FDSSH025 and FDSSH027): TPH-DRO and TPH-GRO (1 duplicate collected for metals, pesticides, PCBs, SVOCs, VOCs, cyanide, TPH-DRO, and TPH-GRO)	***Round 1*** **Groundwater:** 4 shallow wells (024001 – 024004): metals, SVOCs, and VOCs (1 duplicate collected for same parameters)
RFI (EnSafe)	1996 – 1998	***Round 2*** **Soil:** No Soil Samples Collected	***Round 2*** **Groundwater:** 4 shallow wells (024001 – 024004): metals, SVOCs, and VOCs
RFI (EnSafe)	1996 – 1998	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 4 shallow wells (024001 – 024004): metals, SVOCs, and VOCs

Table 4.20.3
Summary of SWMU 24 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/ Samples/Locations	
RFI (EnSafe)	1996 – 1998	***Round 4*** **Soil:** No Soil Samples Collected	***Round 4*** **Groundwater:** 4 shallow wells (024001 – 024004): metals, SVOCs, and VOCs
RFI Addendum (EnSafe)	1999 - 2000	Site investigation to delineate BEQs in soil. **Soil:** 9 surface borings (0 to 1 foot) and 9 subsurface borings (3 to 5 feet) (024SB001 – 024SB004, 024SB009, and 024SB010): SVOCs (024SB005 – 024SB007): metals and SVOCs (2 duplicates collected for metals and SVOCs)	**Groundwater:** No Groundwater Samples Collected.

Nature and Extent

Approximately 17 sample locations associated with SWMU 24 were evaluated for the presence of contaminants between 1996 and 2000. Of these 17, 12 locations are within the boundaries of Combined Drainage Basin 37. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in soil.

4.20.1.3 AOC 607

Site Description and History

AOC 607 is the former dry-cleaning facility at Building 1189, which operated from 1942 to 1986. From 1986, the facility was used as a laundry, housing two industrial washers and dryers. While operating as a dry-cleaning establishment, the facility was classified as a minor emitter of total hydrocarbons. Materials released, stored, or disposed of at the site included perchlorethylene solvent.

Previous Investigations

A summary of investigative activities performed at AOC 607 is presented in Table 4.40.4, which contains the date of the activities, number of soil and shallow groundwater samples collected,

sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone F RFI Report*.

Table 4.20.4
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (607SB001 – 607SB004): SVOCs, VOCs, metals	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** 6 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (607SB005): VOCs, metals (607SB006 – 607SB010): SVOCs, VOCs, metals	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 6 shallow wells (607001 - 607004, 607006, 607007): metals, SVOCs, and VOCs
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 8 shallow wells (607001 -607004, 607006, 607007, 607009): metals, SVOCs, and VOCs (607008): VOCs
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow wells (607008): VOCs
RFI (EnSafe)	1997	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 8 shallow wells (607001 - 607004, 607006, 607007 - 607009): VOCs, SVOCs, and metals

Table 4.20.4
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1997	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 8 shallow wells (607001 - 607004, 607006, 607007 - 607009): VOCs, SVOCs, and metals
RFI (EnSafe)	1998	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** 2 shallow wells (607008 – 607009): VOCs, SVOCs, and metals
MNA (EnSafe)	1998	***Round 9*** **Soil:** No Soil Samples Collected.	***Round 9*** **Groundwater:** 8 shallow wells (607001 – 607004, 607006 - 607009): VOCs, SVOCs, and metals
MNA (EnSafe)	1998	***Round 10*** **Soil:** 7 surface borings (0 to 1 foot) (607SB011 – 607SB015, 607SB017, 607SB018): VOCs	***Round 10*** **Groundwater:** 16 shallow wells (607001 – 607004, 607006 – 607017): VOCs
RFI (EnSafe)	1999	***Round 11*** **Soil:** No Soil Samples Collected.	***Round 11*** **Groundwater:** 16 shallow wells (607001 – 607004, 607006 – 607017): VOCs
RFI (EnSafe)	1999	***Round 12*** **Soil:** No Soil Samples Collected.	***Round 12*** **Groundwater:** 16 shallow wells (607001 – 607004, 607006 – 607017): VOCs
RFI (EnSafe)	1999	***Round 13*** **Soil:** No Soil Samples Collected.	***Round 13*** **Groundwater:** 16 shallow wells (607001 – 607004, 607006 – 607017): VOCs
RFI (EnSafe)	1999	***Round 14*** **Soil:** No Soil Samples Collected.	***Round 14*** **Groundwater:** 8 shallow wells (607010 – 607017): VOCs
RFI (EnSafe)	1999	***Round 15*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (607SB008, 607SB010, 607SB016): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and general chemistry	***Round 15*** **Groundwater:** 8 shallow wells (607001, 607003 – 607004, 607006 – 607008): VOCs (607002): VOCs, and lead (607009): VOCs, and metals

Table 4.20.4
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CH2M-Jones	2000	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 4 shallow wells (607001, 607003 – 607004, 607009): VOCs
CH2M-Jones	2001	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 7 shallow wells (607005, 607018, 607021 – 607024, 607026): VOCs
CH2M-Jones	2001	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 3 shallow wells (607002): metals (607005, 607026): VOCs
CH2M-Jones	2001	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (607P01 - 607P02): VOCs
CH2M-Jones	2001	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 18 shallow wells (607002 – 607004, 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs
CH2M-Jones	2001	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 6 shallow wells (607002, 607003, 607007, 607024, 607030 – 607031): VOCs
CH2M-Jones	2001	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 7 shallow wells (607002 - 607004, 607007, 607024, 607030 – 607031): VOCs
CH2M-Jones	2001	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** 13 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607021, 607024 – 607025, 607027 - 607028, 607030 – 607031): VOCs

Table 4.20.4
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CH2M-Jones	2001	***Round 9*** **Soil:** *No Soil Samples Collected.*	***Round 9*** **Groundwater:** 19 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs
CH2M-Jones	2001	***Round 10*** **Soil:** No Soil Samples Collected.	***Round 10*** **Groundwater:** 19 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs
CH2M-Jones	2001	***Round 11*** **Soil:** No Soil Samples Collected.	***Round 11*** **Groundwater:** 19 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs
CH2M-Jones	2001	***Round 12*** **Soil:** No Soil Samples Collected.	***Round 12*** **Groundwater:** 19 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs
CH2M-Jones	2001	***Round 13*** **Soil:** No Soil Samples Collected.	***Round 13*** **Groundwater:** 19 shallow wells (607002 - 607004, 607006 - 607007, 607011, 607014 – 607017, 607021, 607023 – 607025, 607027 – 607031): VOCs

Nature and Extent of Contaminants

Approximately 45 sample locations associated with AOC 607 were evaluated for the presence of contaminants between 1996 and 2001. Of these 45, approximately 41 sample locations are within the boundaries of Combined Drainage Basin 37. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of vinyl chloride and aluminum in surface soil and tetrachloroethene, vinyl chloride, trichloroethene, arsenic, and

trichloride in shallow groundwater. Based on analytical results, a CMS was recommended for shallow groundwater at AOC 607. CMS activities are currently ongoing.

4.20.1.4 AOC 609

Site Description and History

AOC 609 is the former gasoline station, automotive repair and maintenance shop at Building 1346, which was built in 1962. The focus of the RFI was the waste oil UST at Building 1346. Materials released, stored or disposed of at the site included gasoline, diesel fuel, motor/lubricating oils, degreasing solvents, antifreeze and various automotive products.

USTs were present at the site which contained gasoline and diesel fuel. Three of the original nine steel USTs were found to be leaking in 1991 and were removed. They were replaced with fiberglass tanks in 1992. Subsequently, six monitoring wells were installed by S&ME, Inc., to define the horizontal and vertical extent of groundwater contamination. The assessment report submitted to SCDHEC in February, 1993, resulted in the installation of two additional perimeter wells near the site. All site wells were re-sampled in November 1994, with the results confirming previous findings.

The 560-gallon steel waste oil UST on the west side of the building being assessed in this RFI was removed in 1996. This tank received waste oil from floor drains in the maintenance garage, and was periodically emptied by suctioning to a waste oil truck.

Previous Investigations

A summary of investigative activities performed at AOC 609 is presented in Table 4.40.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone F RFI Report*.

Table 4.40.5
Summary of AOC 609 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1997	Site investigation of soil and groundwater.	
	1996	***Round 1*** **Soil:** 6 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (609SB001 – 609SB006): SVOCs, VOCs, and metals	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) (609SB003): pH, TOC, and cation exchange	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1999	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (609001 – 609002): SVOCs, VOCs, metals, pesticides, and PCBs
RFI (EnSafe)	1999	***Round 4*** **Soil:** 8 surface borings (0 to 1 foot) 8 subsurface borings (3 to 5 feet) (609SB007 – 609SB012): metals (609SB001 – 609SB002): SVOCs, VOCs, metals, pesticides, PCBs, cyanide, and general chemistry	***Round 4*** **Groundwater:** 2 shallow wells (609001 – 609002): VOCs and metals

Nature and Extent of Contaminants

Approximately 16 sample locations associated with AOC 609 were evaluated for the presence of contaminants between 1996 and 1999. Of these 16, approximately 13 sample locations are within the boundaries of Combined Drainage Basin 37. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of arsenic, beryllium, BEQs, antimony, and manganese in surface soil, and benzene, arsenic, toluene, and 4-methyl phenol in shallow groundwater. Based on analytical results, a CMS was recommended for surface soil at AOC 609.

4.20.1.5 AOC 611

Site Description and History

AOC 611 is the former Building 1264, a small garage-sized structure which was used as an

automotive hobby shop from the late 1950s to the early 1960s. The building has since been demolished and the site incorporated into a partially asphalt-paved and grass-covered area. Materials potentially released, stored, or disposed of at the site include petroleum products, antifreeze, isopropyl alcohol, solvents, degreasers, enamel paint, paint thinner, battery acid, and lead.

Previous Investigations

A summary of investigative activities performed at AOC 611 is presented in Table 4.20.6, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone F RFI Report*.

Table 4.20.6
Summary of AOC 611 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1999	Site investigation of soil and groundwater.	
	1996	***Round 1*** **Soil:** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (611SB001 – 611SB004): SVOCs, VOCs, metals, and pH	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 2*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (611SB005 – 611SB007); SVOCs and metals	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1999	***Round 3*** **Soil:** 6 surface borings (0 to 1 foot) 6 subsurface borings (3 to 5 feet) (611SB008 – 611SB011): metals (611SB001S2 –611SB002S2): SVOCs, VOCs, metals, pesticides, PCBs, and cyanide (611SB001T2 –611SB002T2): SVOCs, metals, pesticides, PCBs, TOC, and cyanide	***Round 3*** **Groundwater:** No Groundwater Samples Collected.

Table 4.20.6
Summary of AOC 611 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1999	***Round 4*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (611SB012 – 611SB014): metals	***Round 4*** **Groundwater:** No Groundwater Samples Collected.
CH2M-Jones	2001	***Round 1*** **Soil:** 2 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (611SB017 – 611SB019): metals, SVOCs, and PCBs. (611SB022 – 611SB024): PCBs.	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 19 sample locations associated with AOC 611 were evaluated for the presence of contaminants between 1996 and 2001. Of these 19, 2 sample locations are within the boundaries of Combined Drainage Basin 37. Surface and subsurface samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of arsenic, BEQs, mercury, and chromium in surface soil.

4.20.1.6 AOC 613

Site Description and History

AOC 613 is located at the former Building 1169, a former locomotive and crane repair facility which operated from the 1930s until 1985, at which time the building was demolished. Maintenance activities included changing oil, repairing hydraulic systems and overhauling equipment. Materials released, stored, or disposed of at the site included oil, grease, diesel fuel, and cleaning solvents. Numerous spills were reported, some to the storm water drainage system. In addition, a UST at the site allegedly contained waste oil and other waste liquids. Documentation of an apparent removal of this UST was unavailable. Building 242, built in 1987, occupies a portion of the site area.

Previous Investigations

A summary of investigative activities performed at AOC 613 is presented in Table 4.20.7, which contains the date of the activities, number of soil and shallow groundwater samples collected,

sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone F RFI Report*.

Table 4.20.7
Summary of AOC 613 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1999	Site investigation of soil and groundwater.	
	1996	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 4 shallow wells (613001, 613003, 613004, and 613005): SVOCs, VOCs, and metals
RFI (EnSafe)	1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 4 shallow wells (613001, 613003, 613004, and 613005): SVOCs, VOCs, and metals
RFI (EnSafe)	1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 4 shallow wells (613001, 613003, 613004, and 613005): SVOCs, VOCs, and metals
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 4 shallow wells (613001, 613003, 613004, and 613005): SVOCs, VOCs, and metals
RFI (EnSafe)	1998	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (613006): SVOCs, VOCs, and metals
RFI (EnSafe)	1999	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 1 shallow well (613006): SVOCs, VOCs, metals, cyanide, pesticides, and PCBs

Table 4.20.7
Summary of AOC 613 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1999	***Round 7*** **Soil:** 19 surface borings (0 to 1 foot) 19 subsurface borings (3 to 5 feet) (613SB001 through 613SB014, and 613SB016): SVOCs and metals (613SB019 through 613SB022): metals	***Round 7*** **Groundwater:** 2 shallow wells (613001): VOCs (613006): SVOCs, VOCs, and metals
RFI (EnSafe)	*1999*	***Round 8*** ***Soil:*** 10 surface borings (0 to 1 foot) 9 subsurface borings (3 to 5 feet) (613SB021 through 613SB022): SVOCs (613SB023 through 613SB026): SVOCs and metals	***Round 8*** **Groundwater:** 2 shallow wells (613007): SVOCs, VOCs, and metals (613008): VOCs
RFI (EnSafe)	1999	***Round 9*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (613SB029 through 613SB030): SVOCs and metals	***Round 9*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 38 sample locations associated with AOC 613 were evaluated for the presence of contaminants between 1995 and 1999. Of these 38, approximately 19 sample locations are within the boundaries of Combined Drainage Basin 37. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of arsenic, beryllium, BEQs, and aluminum in soil, and arsenic, benzene, beryllium, bis(2-ethylhexyl)phthalate, acenapthene, fluorine, 2-methylnapthalene, and phenanthrene shallow groundwater.

4.20.2 Storm Water Effluent Evaluation

Two storm water effluent samples were collected from manholes associated with Combined Drainage Basin 37. Sample EFF028 was collected at manhole 37/3 on July 23, 2002, while EFF072 was collected at manhole 37/7 on July 11, 2002. These effluent samples were collected and analyzed to determine if constituents are migrating from the SWMUs/AOCs associated with

Combined Drainage Basin 37 into the Cooper River. Analytical detections for samples EFF028 and EFF072 are presented in Table 4.20.8.

Table 4.20.8
Storm Water Effluent Sampling Results
Combined Drainage Basin 37

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
37	37/3	EFF028	Aluminum	890	3,277	NL	No
			Barium	15	60.31	NL	No
			Calcium*	55,000	53,455	NL	No
			Chromium	8.80	13	50	No
			Copper	9.30	41.98	2.90	No
			Iron	1,300	4,134	NL	No
			Lead	10	33.63	8.50	No
			Magnesium*	140,000	49,255	NL	No
			Manganese	29	74.52	NL	No
			Nickel	2.40	5.14	8.30	No
			Potassium*	51,000	23,678	NL	No
			Sodium*	1,100,000	395,333	NL	No
			Vanadium	9.20	15.59	NL	No
			Zinc	41	307.83	86	No
			Benzo(a)pyrene	**0.78**	**NL**	**NL**	**Yes**
			Benzo(g,h,i) perylene	**0.71**	**NL**	**NL**	**Yes**
			Bis(2-Ethylhexyl) phthalate	**1.50**	**NL**	**NL**	**Yes**
			Di-n-butylphthalate	0.76	NL	3.4	No
			Indeno(1,2,3-cd) pyrene	**0.71**	**NL**	**NL**	**Yes**
	37/7	EFF072	Aluminum	1,400	3,277	NL	No
			Barium	18	60.31	NL	No
			Calcium*	6,900	53,455	NL	No
			Chromium	4.10	13	50	No
			Copper	21	41.98	2.90	No
			Iron	2,700	4,134	NL	No
			Lead	18	33.63	8.50	No
			Magnesium*	2,900	49,255	NL	No
			Manganese	26	74.52	NL	No
			Nickel	2.40	5.14	8.30	No
			Potassium*	3,200	23,678	NL	No
			Sodium*	20,000	395,333	NL	No

Table 4.20.8
Storm Water Effluent Sampling Results
Combined Drainage Basin 37

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Vanadium	8.30	15.59	NL	No
			Zinc	89	307.83	86	No
			1,4-Dichlorobenzene	**0.33**	**NL**	**NL**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.20.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of *the Storm Water Effluent Evaluation Report* and determine the applicability of each scenario to Combined Drainage Basin 37. Table 4.20.9 summarizes the migration pathway scenarios.

Table 4.20.9
Storm Water Contaminant Migration Pathway Scenario Summary
Combined Drainage Basin 37

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	Yes
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.20.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. The EBS for building 241 states that there is a history of oil, grease, diesel fuel, and chemical cleaning solutions being spilled and entering the storm sewer system around the building.

There is linkage evidence between historical releases and the effluent PAH data for EFF028. Further assessment of the data is warranted during the COPC refinement process to determine if the low concentrations of the PAHs detected in the effluent will necessitate a SLERA.

4.20.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that two catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone E background concentrations and the ecological risk based screening criteria identified five areas which have the potential to provide an upland source consistent with EFF028 COPCs for entry into the storm sewer system. A summary of this evaluation is provided in Table 4.20.10.

Table 4.20.10
Combined Drainage Basin 37
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

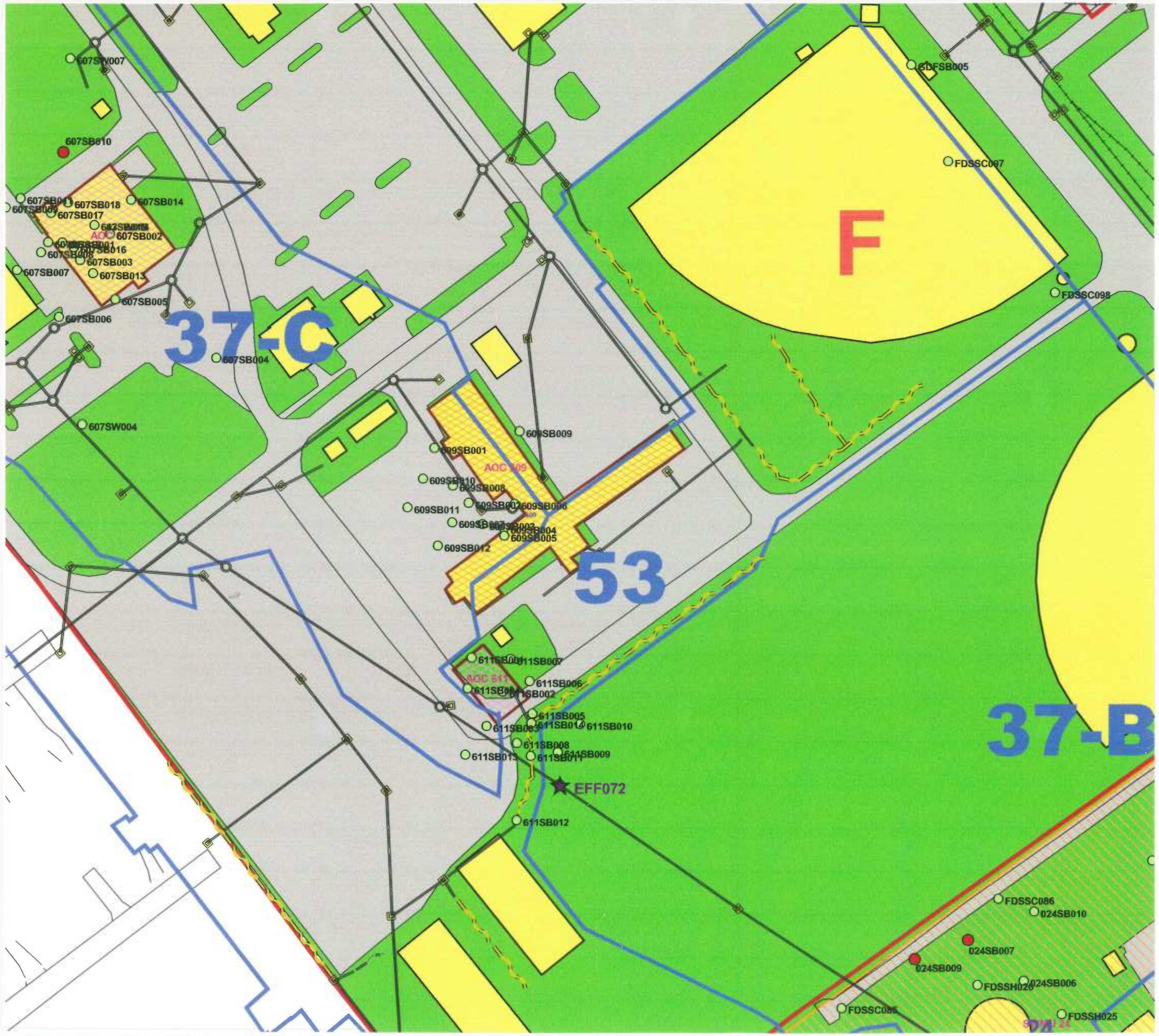
Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Value (mg/kg)	Distance to Catch Basin#
37/5-A	024SB007	Benzo(g,h,i)perylene	0.12	NL	133
	024SB009	Benzo(g,h,i)perylene	0.056	NL	164
37/12/4-6/1-A	607SB010	Benzo(g,h,i)perylene	0.21	NL	89
37/10/1-B	*609SB006	Benzo(g,h,i)perylene	0.044	NL	4.00
37/8-A	*611SB003	Benzo(g,h,i)perylene	0.044	NL	36

Notes:
* = Sample location is located under pavement and constituents from these locations most likely do not represent complete exposure pathways to the storm water system.

Evaluation of surface soil data to determine possible upland terrestrial source identification with EFF028 and EFF072 COPCs revealed that benzo(g,h,i)perylene was detected in surface soil within 4 to 164 feet from catch basins within Combined Drainage Basin 37. Therefore, the pathway is complete for benzo(g,h,i)perylene. The benzo(g,h,i)perylene detections will be further evaluated during the SLERA process. Figure 4-20A illustrates the soil locations and their proximity to the catch basins. There were no upland source areas for the other potential COPCs identified in Table 4.20.8 for Scenario 1b.

4.20.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Combined Drainage Basin 37 were reviewed. The preliminary evaluation identified one groundwater location contaminated with bis(2-Ethylhexyl)phthalate intercepting the storm water drainage pipeline within Combined Drainage Basin 37. However, there were no other detections in groundwater from any



100 0 100 Feet

N

LEGEND

- Soil Linkage Sample
- Surface Soil Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-20A
Drainage Basin 37
Soil Sample Linkage Locations

November 2002 | Zone J Main Project.apr

other wells upgradient or down gradient of the storm water line. Therefore, the pathway is not complete for any of the storm water effluent COPCs.

4.20.3.4 Scenario 1d

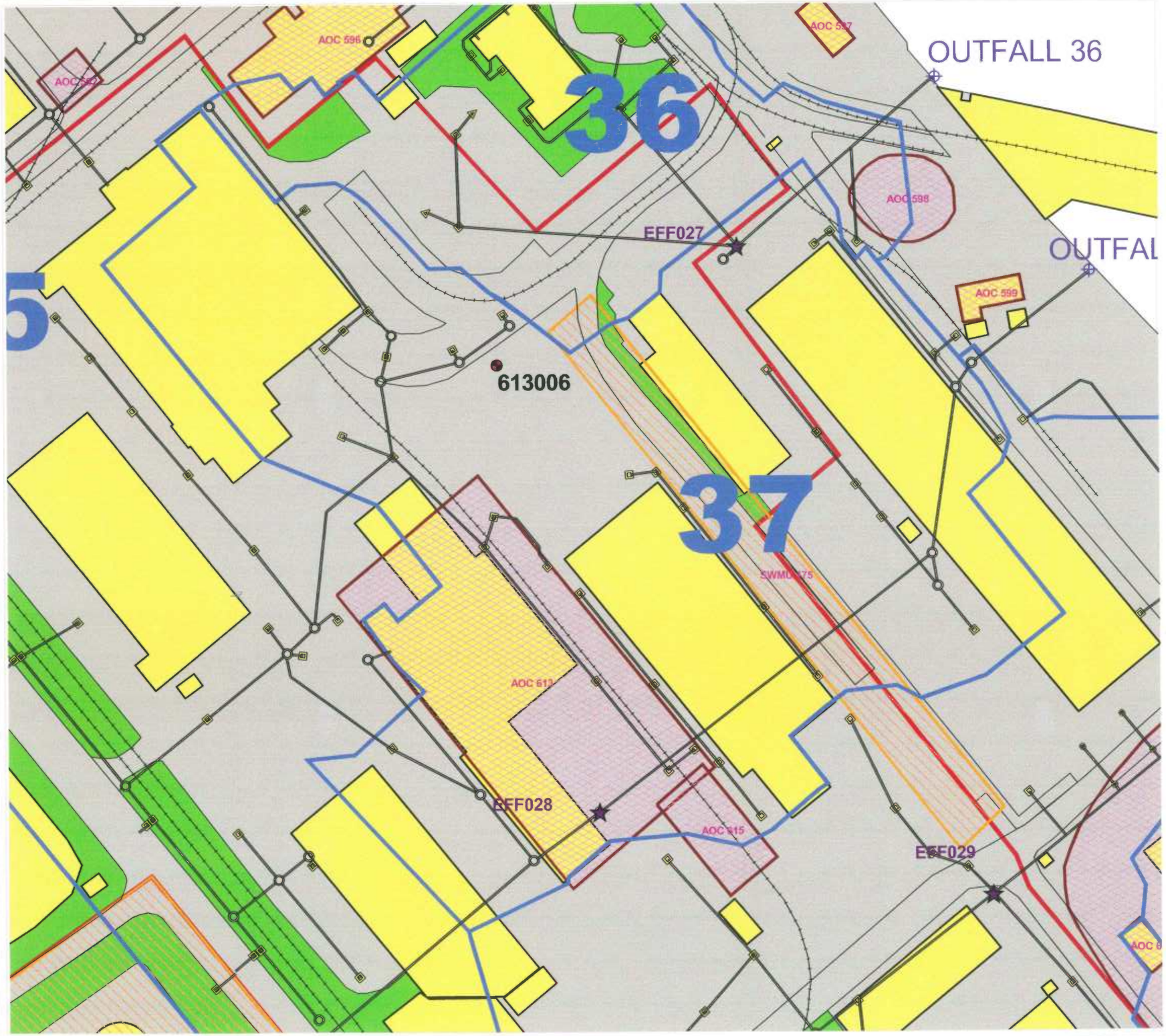
Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Combined Drainage Basin 37.

4.20.4 Summary of Potential COPCs

Table 4.20.12 summarizes the potential COPCs that have been included for further characterization of Combined Drainage Basin 37.

Table 4.20.12
Summary of Potential COPCs
Combined Drainage Basin 37

Potential COPC	Pathway of Concern
Benzo(g,h,i)perylene	Scenario 1b



100 0 100 Feet

N

LEGEND

- Groundwater Linkage Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-20B
Drainage Basin 37
Groundwater Sample Linkage Locations

November 2002 | Zone J Main Project.apr

4.21 Drainage Basin 38

Drainage Basin 38 encompasses approximately 22 acres within Zones E and F in the central section of the CNC. Land cover within the basin consists of approximately 10% unpaved surfaces, 50% paved surfaces, and 40% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the 80 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 38.

Figure 4-21 illustrates the area encompassing Drainage Basin 38 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.21.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are seven SWMUs/AOCs that are either partially or completely within the boundary of Drainage Basin 38. The sites are listed in Table 4.21.1 with the current status of each site. All sites were included in the Zone J data evaluation. These sites include SWMU 4 (Pesticide Storage Building, Building 328), AOC 602 (Substation and Storage, Building 95), AOC 613 (Old Locomotive Repair Shop, Former Building 1169), AOC 615 (Old Chain Locker, Building 95), AOC 616 (Paint Shop, Building 69 Parking Area), AOC 617 (Galvanizing Plant, Building 69A Area), AOC 619 (Oil Storage Yard, Building 1824 Area). SWMU 4/AOC 619 and AOC613/615 were combined into one investigation due to their close proximity and their potential for similar COPCs.

Table 4.21.1
Drainage Basin 38 AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 4	Pesticide Storage Building, Building 381	Draft RFI Report; RFA Report Addendum; NFA
AOC 602	Substation and Storage, Building 95	Draft RFI Submitted; Comments Received on 6/30/99
AOC 613	Old Locomotive Repair Shop, Former Building 1169	Draft RFI Report; RFI Work Plan Addendum; RFI Report Addendum; CMS Work Plan
AOC 615	Old Chain Locker, Building 255 Area	Draft RFI Report RFI Work Plan Addendum; RFI Report Addendum; CMS Work Plan
AOC 616	Paint Shop, Building 69 Parking Area	Draft RFI Report

N

200 0 200 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-21
Drainage Basin 38

November 2002 | Zone J Main Project.apr

Table 4.21.1
Drainage Basin 38 AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 617	Galvanizing Plant, Building 69A Area	Draft RFI Report; RFI Work Plan Addendum; RFI Report Addendum; CMS Work Plan; CMS Report
AOC 619	Oil Storage Yard, Building 1824 Area	RFI Report Addendum; NFA

4.21.1.1 SWMU 4 and AOC 619

Site Description and History

SWMU 4 is a building used to store various insecticides and rodenticides since 1980. The building has a formulation and mixing room, and equipment wash area, and sink and floor drains connected to the base sanitary sewer system. Pesticide storage at the facility was discontinued after 1985, and afterward the building was used for miscellaneous storage only. Materials released, stored or disposed of at the facility included various pesticides. AOC 619 (a CSI site) is a former oil storage yard used from 1955 to 1982 to store waste oil, possibly in an open pit. The possibility of an open pit storage area, along with the observation of stressed vegetation in the area were noted as increasing the potential for contamination at this site. Materials released, stored, or disposed of at this site included petroleum products.

Previous Investigations

The RFI is the only investigation that has been conducted for SWMU 4/AOC 619. A summary of investigative activities is presented in Table 4.21.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone F RFI Report*.

Table 4.21.2
Summary of SWMU 4/AOC 619 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater samples.	
		Round 1	***Round 1***

Table 4.21.2
Summary of SWMU 4/AOC 619 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		Soil: 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (004SB001 – 004SB004): herbicides, metals, OP pesticides, pesticides, PCBs, SVOCs, VOCs (2 duplicates collected for Appendix IX parameters) 14 surface borings (0 to 1 foot) 14 subsurface borings (3 to 5 feet) (619SB001-619SB015): cyanide, metals, pesticides, PCBs, SVOCs, VOCs (2 duplicates collected for Appendix IX parameters) 8 subsurface soil borings (619SB001, 619SB003, 619SB004, 619SB009-619SB010, 619SB012-619SB014): cyanide, metals, pesticides, PCBs, SVOCs, VOCs	**Groundwater:** 4 shallow wells (619001-619004): metals, OP pesticides, pesticides, PCBs, SVOCs, VOCs
RFI (EnSafe)	1997	***Round 2, 3, and 4*** **Soil:** No Soil Samples Collected.	***Round 2, 3, and 4*** **Groundwater:** 4 shallow wells (619001-619004): metals, pesticides, PCBs, SVOCs, VOCs
RFI (EnSafe)	1999	***Round 5*** **Soil:** 6 surface borings (0 to 1 foot) 6 subsurface boring (3 to 5 feet) (619SB015-619SB020): metals, pesticides, PCBs, SVOCs, VOCs, cyanide 2 surface borings (0 to 1 foot) 2 subsurface boring (3 to 5 feet) (619SB014-619SB015): SPLP for cyanide, pesticides, PCBs, metals, SVOCs, VOCs	***Round 5*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Twenty eight sample locations associated with SWMU 4/AOC 619 were evaluated for the presence of contaminants between 1996 and 1999. Of the 28 locations, 26 are within the boundaries of Drainage Basin 38. Surface, subsurface, and groundwater were collected and analyzed for metals, cyanide, pesticides, PCBs, SVOCs, VOCs, and the Appendix IX parameters (OP pesticides,

herbicides, dioxins, hexavalent chromium) in order to delineate the nature and extent of potential contamination attributable to substation and previous activities at the site. Of particular interest were detections of manganese and BEQs in soil and thallium and chloromethane in groundwater, however, based on the results of the risk assessment during the RFI, no further action was recommended.

4.21.1.2 AOC 602

Site Description and History

AOC 602 is a former electrical substation at Building 95. It is bound by Dry Dock No. 3 to the north, River Road to the south, and open paved areas to the east and west. Constructed in 1943, Building 95 was originally used as an electrical substation for Dry Dock 3. It housed PCB-containing transformers until it was renovated in 1989. Hurricane Hugo interrupted those renovation activities, and the building was subsequently taken out of service. Currently this area is paved with concrete/asphalt.

Previous Investigations

This site has not been investigated previously, but in 1986, fluid samples collected from the transformer indicated PCB concentrations were less than 50 ppm. During the RCRA Facility Assessment (RFA), stains were observed on the floor. The RFI is the only investigation that has been conducted for AOC 602. A summary of investigative activities is presented in Table 4.21.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone F RFI Report.*

Table 4.21.3
Summary of AOC 602 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1997	Site investigation of soil samples.	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Table 4.21.3
Summary of AOC 602 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
		(602SB001 – 602SB004): PCBs.

Nature and Extent of Contaminants

Four sample locations associated with SWMU 602 were evaluated for the presence of contaminants in 1996 and 1997. Of the four locations, one is within the boundaries of Drainage Basin 38. Surface, and subsurface samples were collected and analyzed for PCBs in order to delineate the nature and extent of potential contamination attributable to substation and previous activities at the site. Of particular interest were detections of PCBs 1254 and 1260 in soil.

4.21.1.3 AOC 613/615
Site Description and History

AOC 613 is located at the former Building 1169, a former locomotive and crane repair facility which operated from the 1930s until 1985, when the building was demolished. Maintenance activities included changing oil, repairing hydraulic systems and equipment overhaul. Materials released, stored, or disposed of at the site included oil, grease, diesel fuel, and cleaning solvents. Numerous spills were reported, some to the storm water drainage system. In addition, a UST at the site allegedly contained waste oil and other waste liquids. Documentation of an apparent removal of this UST was unavailable. Building 242, built in 1987, occupies a portion of the site area.

AOC 615 is the site of the former Building 1391, the former chain locker. Operated from 1970 to 1977, the site was used to store and service anchor chain. Materials released, stored, or disposed of at the site included epoxies and resins. These materials were stored in large tanks onsite, used for dipping anchor chain sections. Epoxy and resin wastes were reportedly stored in 55-gallon drums behind the building.

These sites were combined into one investigation due to their close proximity and their potential for similar COPCs.

Previous Investigations

The RFI has been completed and the investigation is currently in the CMS stage for AOCs 613 and 615. A summary of investigative activities is presented in Table 4.21.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone F RFI Report*.

Table 4.21.4
Summary of AOC 613/615 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996- 1999	Site investigation of soil and groundwater.	
		Round 1 **Soil**: No Soil Samples Collected. **Sediment:** 2 sediment samples (613M0001 – 613M0002): VOCs, SVOCs, metals, cyanide.	***Round 1*** **Groundwater:** 4 shallow wells (613001,613003-613005): SVOCs, VOCs, metals
RFI (EnSafe)	1997	***Round 2, 3, and 4*** **Soil:** No Soil Samples Collected.	***Round 2, 3, and 4*** **Groundwater:** 4 shallow wells (613001,613003-613005): SVOCs, VOCs, and metals
RFI (EnSafe)	1998	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (613006): SVOCs, VOCs, metals
RFI (EnSafe)	1999	***Round 6 and 7*** **Soil:** 30 surface borings (0 to 1 foot) 30 subsurface borings (3 to 5 feet) (613SB001-613SB030): metals, SVOCs, VOCs (1 duplicate collected for Appendix IX parameters) 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) samples collected for SPLP: cyanide, metals. SVOCs, VOCs, pesticides, PCBs	***Round 6 and 7*** **Groundwater:** 3 shallow wells (613006, 613007-613008): SVOCs, VOCs, metals

Table 4.21.4
Summary of AOC 613/615 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (CH2MHill)	2002	***Round 1*** **Soil**: 6 subsurface borings (3 to 5 feet) (712SB001-714SB003 and 714SB001-714SB003): VOCs, SVOCs, pesticides, PCBs, metals	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Thirty-eight sample locations associated with AOC 613/615 were evaluated for the presence of contaminants between 1995 and 2002. Of the 38 locations, 12 are within the boundaries of Drainage Basin 38. Surface and subsurface samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to previous activities at the site. Of particular interest were detections of arsenic, beryllium and BEQs in soil, and aluminum, arsenic, benzene, chlorobenzene, 2,4-dichlorophenol, ethylbenzene, 2-methylphenol, 4-methylphenol, naphthalene, toluene, and xylene in groundwater. Surface soil and shallow and deep groundwater were recommended for CMS.

4.21.1.4 AOC 616

Site Description and History

AOC 616 is the former Building 1201, which operated as a paint shop from 1955 to 1977. The building has since been demolished and the site incorporated into a parking and storage lot for Building 69. Materials released, stored or disposed of at the site are paint thinner, solvents, and paint supply products.

Previous Investigations

The RFI has been the only investigation for AOC 616. A summary of investigative activities is presented in Table 4.21.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone F RFI Report*.

Table 4.21.5
Summary of AOC 616 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil.	
		Round 1 **Soil**: 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (616SB001 – 616SB004): VOCs, SVOCs, metals	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1999	***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) 1 subsurface boring (3 to 5 feet) Sampled for SPLP cyanide, metals, pesticides, PCBs, SVOCs, VOCs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Four sample locations associated with AOC 616 were evaluated for the presence of contaminants between 1996 and 1999. All four locations are within the boundaries of Drainage Basin 38. Surface and subsurface samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to previous activities at the site.

4.21.1.5 AOC 617

Site Description and History

AOC 617 is the former Building 1176, which operated as a galvanizing plant from the early 1940s to approximately 1985. A 3,000 gallon UST apparently was used for onsite chemical storage. The building has since been demolished and Building 69, a shipping and supply center was constructed in the general area. Materials released, stored or disposed of at the site included zinc solutions and inorganic acids.

Previous Investigations

The RFI has been completed and the investigation is currently in the CMS stage for AOCs 617. A summary of investigative activities is presented in Table 4.21.6, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are

presented in the *Draft Zone F RFI Report*.

Table 4.21.6
Summary of AOC 617 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater samples.	
		Round 1 **Soil**: 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (617SB001 – 617SB004): VOCs, SVOCs, metals, pesticides, PCBs (1 duplicate collected for Appendix IX parameters)	***Round 1*** **Groundwater:** 2 shallow wells (617001-617002): metals, SVOCs, VOCs
RFI (EnSafe)	1997	***Round 2, 3, and 4*** **Soil**: No Soil Samples Collected.	***Round 2, 3, and 4*** **Groundwater:** 2 shallow wells (617001-617002): metals, SVOCs, VOCs
RFI (EnSafe)	1999	***Round 5*** **Soil**: 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (617SB003-617SB004): SPLP metals, pesticides, PCBs, VOCs, SVOCs, cyanide	***Round 5*** **Groundwater:** 1 shallow well (617003): metals, SVOCs, VOCs

Nature and Extent of Contaminants

Seven sample locations associated with AOC 617 were evaluated for the presence of contaminants between 1996 and 1999. All seven locations are within the boundaries of Drainage Basin 38. Surface and subsurface samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to previous activities at the site. Of particular interest were detections BEQs in soil and aluminum, arsenic, cadmium, cobalt, manganese, nickel, thallium, and zinc. A CMS was recommended for this site.

4.21.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 38/4 on June 18, 2002 to determine if constituents are migrating from the AOCs associated with Drainage Basin 38 into the Cooper River.

Analytical detections for sample EFF029 are presented in Table 4.21.7.

Table 4.21.7
Storm Water Effluent Sampling Results
Drainage Basin 38

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
38	38/4	EFF029	**Aluminum**	**26,200**	**3,277**	**NL**	**Yes**
			Barium	18	60.31	NL	No
			Calcium*	21,000	53,455	NL	No
			Chromium	9.20	13	50	No
			Cobalt	1.00	2.00	NL	No
			Copper	25	41.98	2.90	No
			Iron	2,900	4,134	NL	No
			Lead	26	33.63	8.50	No
			Magnesium*	9,700	49,255	NL	No
			Manganese	66	74.52	NL	No
			Nickel	3.50	5.14	8.30	No
			Potassium*	4,100	23,678	NL	No
			Sodium*	76,000	395,333	NL	No
			Vanadium	9.60	15.59	NL	No
			Zinc	250	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.21.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 in the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 38. Table 4.21.8 summarizes the migration pathway scenarios.

Table 4.21.8
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 38

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes

Table 4.21.8
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 38

Scenario	Pathway Description	Is Pathway Complete?
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.21.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS for Facility 1193, the following chemicals may have been used for the treatment of water in the boiler: caustic soda, sodium sulfate, disodium phosphate, and cyclohexylamine. The boiler waste from this facility was typically discharged to the storm water sewer system. At facility 382 an incident report dated April 9, 1984 indicated that heavy rain forced oil out of the storm water drainage system. This oil was suspected to have been left from a spill on December 30, 1984.

Facility 303/303B (Dry Dock 3) according to the EBS had reported a number of POL and paint spills with the wastewater being drained to the sump, then to the Cooper River.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF029 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.21.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that at least one of 80 catch basins are

near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone F background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source of aluminum in the storm sewer system.

4.21.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 38 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with aluminum intercepting the storm water drainage pipeline within Drainage Basin 38.

4.21.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 38. Information obtained from the Davis and Floyd Study, the *Zone L RFI Report,* and *Process Closure for SWMU 37 Dye Test Cross-connect Resolution in Buildings 3, 9, and 68* Completion Report (Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP) Nov, 1998) indicates that there were cross-connects present from Building 69 in Drainage Basin 38. These cross-connects were not reported to have been eliminated prior to publication of the Completion Report. No other cross-connects were reported from the Zone L dye test program.

4.21.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 38 due to a lack of an upland terrestrial source identification.

4.22 Drainage Basin 39

Drainage Basin 39 encompasses approximately 0.6 acres within Zone E. Land cover within the drainage basin consists of approximately 95% paved surfaces and 5% building foundations. Storm water runoff within the drainage basin is directed to one of two catch basins connected to storm sewer pipelines that discharge to the Cooper River via Outfall 39.

Figure 4-22 illustrates the area encompassing Drainage Basin 39 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.22.1 Potential Source Areas

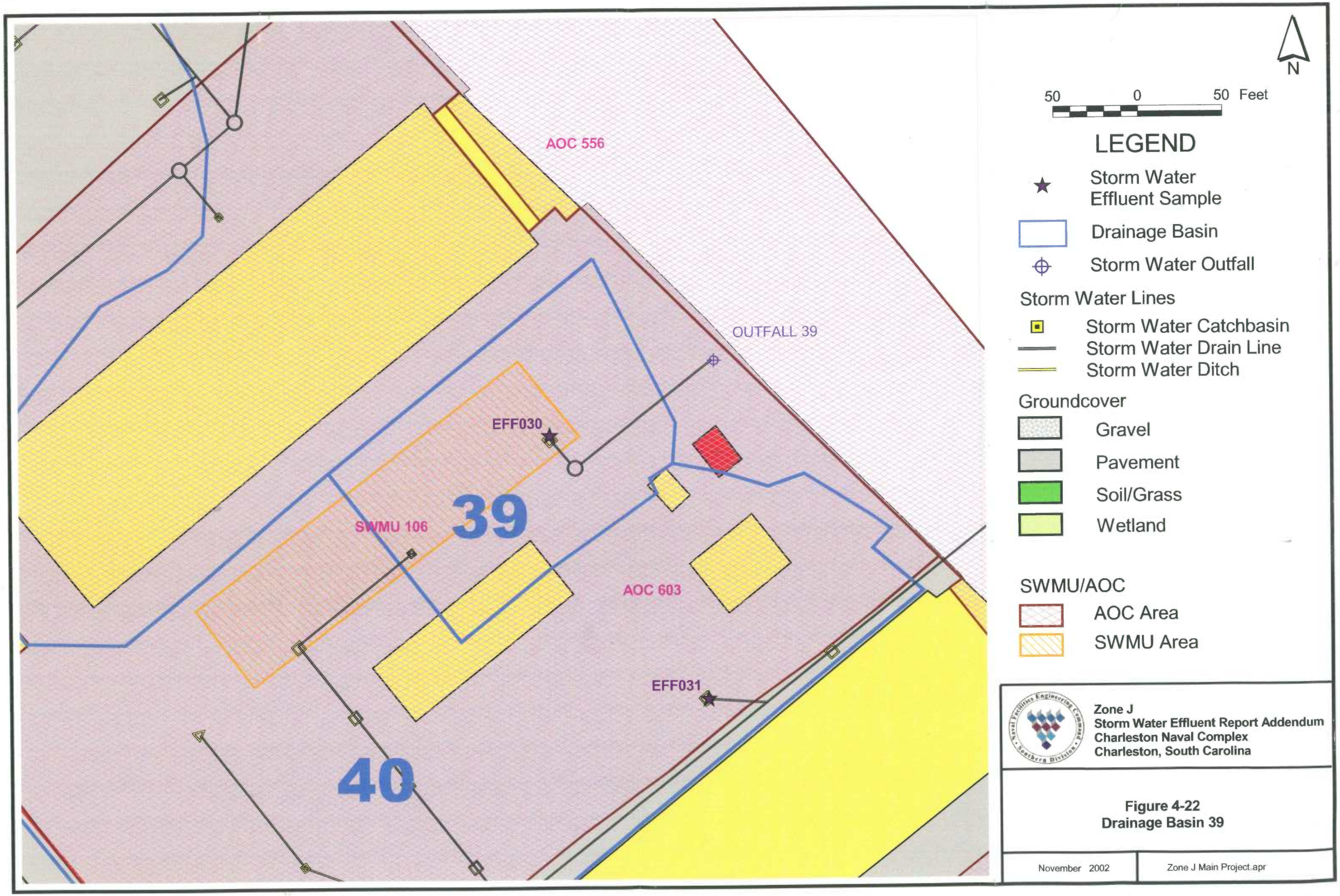
A review of the listing of sites in Appendix A of the Part B permit indicates that there are two SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 39. The sites are listed in Table 4.22.1, along with their current status. Draft RFIs for each of the potential source areas were submitted to SCDHEC. For this basin assessment, approximately 50% of SWMU 106 lies in Drainage Basin 39, while the remaining 50% lies in Drainage Basin 40. Note that due to their proximity to each other, SWMU 106 and AOC 603 are assessed together; however, no sample locations associated with AOC 603 are within Drainage Basin 39.

Table 4.22.1
Drainage Basin 39 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 106	Blast Area Dry Dock #3	Draft RFI Report; RFI Report Addendum
AOC 603	Burning Dump	Draft RFI Report; RFI Report Addendum

4.22.1.1 SWMU 106/AOC 603
Site Description and History

SWMU 106 consists of an abrasive blasting area near Drydocks 3 and 4. The site outside on an area paved with asphalt/concrete; however, this area at one time was merely graded and covered with rock. When blasting operations occurred, temporary structures were erected using scaffolding and herculite to contain blast material. Steel grit and sodium bicarbonate are the reported materials used for blasting, although blasting operations are rarely conducted here.


N
50 0 50 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
AOC 556
OUTFALL 39
EFF030
39
SWMU 106
AOC 603
EFF031
40
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-22
Drainage Basin 39
November 2002
Zone J Main Project.apr

AOC 603 site consists of an area near the present location of Drydock 3 where a burning dump was operated from the late 1920s through the 1930s.

Materials of concern identified in the *Draft Zone E RFI Work Plan* include metals, paints, solvents, and blasting material at SWMU 106. Petroleum hydrocarbons and products of incomplete combustion are the materials of concern at AOC 603. Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area may support following base closure.

Previous Investigations

A summary of investigative activities performed at SWMU 106/AOC 603 is presented in Table 4.22.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.22.2
Summary of SWMU 106/AOC 603 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 - 1997	Site soil and groundwater investigation ***Round 1*** **Soil:** 7 surface borings (0 to 1 foot) 7 subsurface borings (3 to 5 feet) (106SB001): VOCs, SVOCs, metals, cyanide, pesticides, PCBs, pH, and organotins (106002 - 106SB003; 603SB001 – 603SB004): VOCs, SVOCs, metals, cyanide, pesticides, PCBs, and organotins	***Round 1*** **Groundwater:** 1 shallow well (106001): VOCs, SVOCs, metals, cyanide, pesticides, PCBs, chlorides, sulfates, TDS, and organotins
RFI (EnSafe)	1995 - 1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (106001): SVOCs, metals, chlorides, sulfates, TDS, and organotins

Table 4.22.2
Summary of SWMU 106/AOC 603 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995 - 1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 4 shallow well (106001): metals, chlorides, sulfates, and TDS
RFI (EnSafe)	1995 - 1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 4 shallow well (106001): metals, chlorides, sulfates, and TDS

Nature and Extent of Contaminants

Approximately nine sample locations for SWMU 106/AOC 603 were collected and analyzed for various methods between 1995 and 1997. Of these eight, approximately four sample locations were within the boundaries of Drainage Basin 39. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site attributable to possible spills occurring in the area. Chemicals of particular interest included arsenic and BEQs in surface soil and arsenic in shallow groundwater groundwater. Based on the analytical results and the human health risk assessment for the site, a CMS was recommended for groundwater at SWMU 106/AOC603.

4.22.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at catch basin 39/1-A on June 22, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 39 into the Cooper River. Analytical detections for sample EFF030 are presented in Table 4.22.3.

Table 4.22.3
Storm Water Effluent Sampling Results
Drainage Basin 39

Drainage	Catch	Concentration	Screening Value (μg/L)	Potential

					Reference Concentration	Chronic Saltwater Screening Value	
39	39/1-A	EFF030	Aluminum	59	3,277	NL	No
			Barium	1.90	60.31	NL	No
			Calcium*	2,800	53,455	NL	No
			Copper	8.40	41.98	2.90	No
			Iron	66	4,134	NL	No
			Magnesium*	86	49,255	NL	No
			Manganese	2.00	74.52	NL	No
			Potassium*	98	23,678	NL	No
			Sodium*	430	395,333	NL	No
			Vanadium	1.80	15.59	NL	No
			Zinc	9.50	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.22.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 39. Table 4.22.4 summarizes the migration pathway scenarios.

Table 4.22.4
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 39

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.22.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels

through the storm water drainage pipeline into Zone J water bodies. Facility 303/303B (Dry Dock 3) according to the EBS had reported a number of POL and paint spills with the wastewater being drained to the sump, then to the Cooper River.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF030 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

There were no potential storm water effluent COPCs identified for Drainage Basin 39 that require further characterization; therefore contaminant migration pathway scenarios 1b through 1d do not require further evaluation.

4.23 Drainage Basin 40

Drainage Basin 40 encompasses approximately 2.56 acres within Zone E. Land cover within the drainage basin consists of approximately 95% paved surfaces and 5% building foundations. Storm water runoff within the drainage basin is directed to one of nine catch basins connected to storm sewer pipelines that discharge to the Cooper River via Outfall 40.

Figure 4-23 illustrates the area encompassing Drainage Basin 40 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.23.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there are three SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 40. The site is listed in Table 4.23.1, along with its current status. Draft RFIs for each of the potential source areas were submitted to the SCDHEC. For this basin assessment, approximately 50% of SWMU 106 lies in Drainage Basin 40, while the remaining 50% lies in Drainage Basin 39. Note that due to their proximity to each other, SWMU 106 and AOC 603 are assessed together.

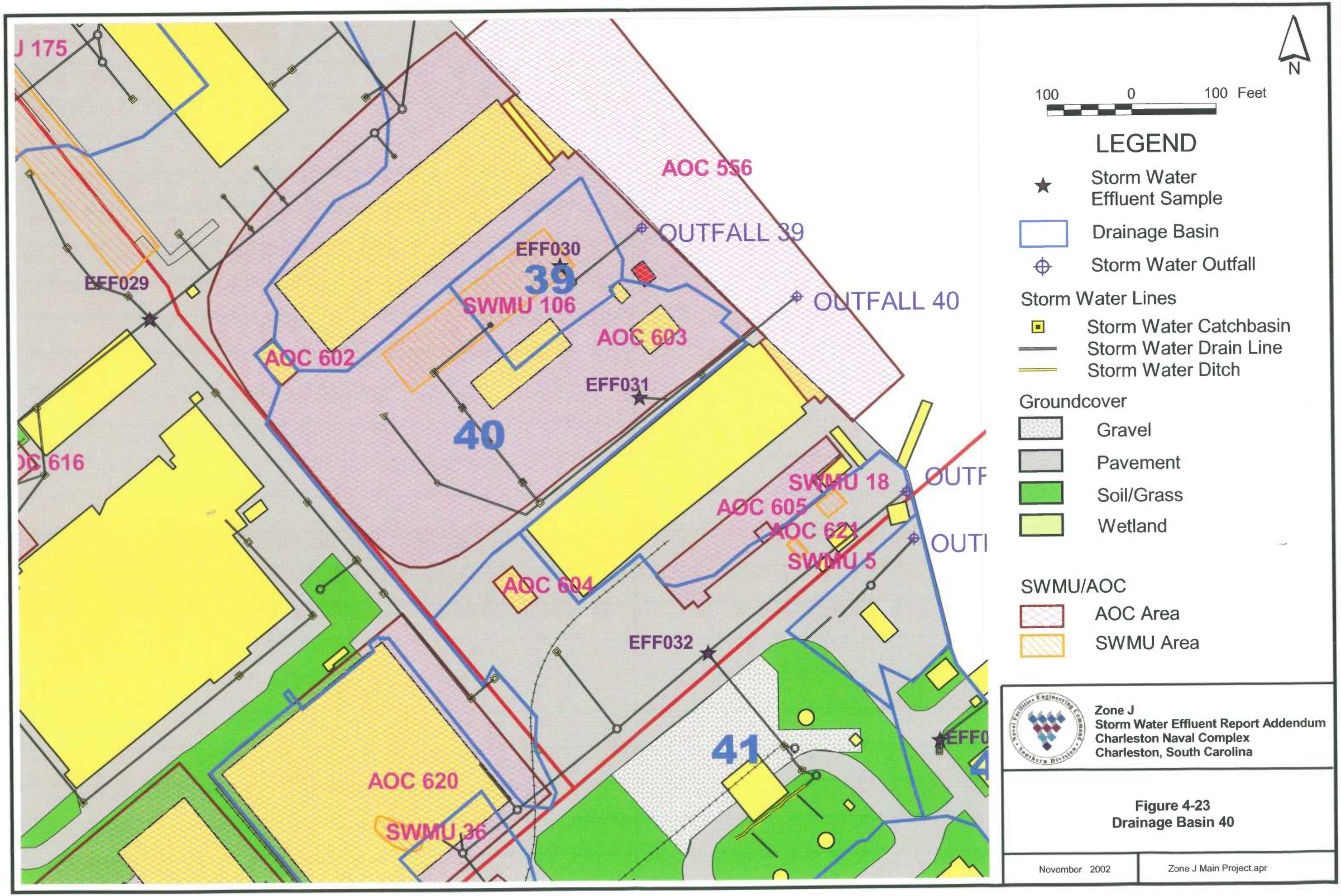
Table 4.23.1
Drainage Basin 40 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 106	Blast Area Dry Dock #3	Draft RFI Report; RFI Report Addendum
AOC 602	Substation and Storage Bldg. 95	Draft RFI Report; RFI Report Addendum
AOC 603	Burning Dump	Draft RFI Report; RFI Report Addendum

4.23.1.1 SWMU 106/AOC 603
Site Description and History

SWMU 106 consists of an abrasive blasting area near Drydocks 3 and 4. The site outside on an area paved with asphalt/concrete; however, this area at one time was merely graded and covered with rock. When blasting operations occurred, temporary structures were erected using scaffolding and herculite to contain blast material. Steel grit and sodium bicarbonate are the reported materials used for blasting, although blasting operations are rarely conducted here.

AOC 603 site consists of an area near the present location of Drydock 3 where a burning dump was


J 175
AOC 556
OUTFALL 39
OUTFALL 40
EFF030
39
SWMU 106
AOC 603
EFF029
AOC 602
EFF031
40
OC 616
SWMU 18
OUTF
AOC 605
AOC 621
OUTI
SWMU 5
AOC 604
EFF032
41
EFF0
4
AOC 620
SWMU 36
N
100 0 100 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-23
Drainage Basin 40
November 2002
Zone J Main Project.apr

operated from the late 1920s through the 1930s.

Materials of concern identified in the *Draft Zone E RFI Work Plan* include metals, paints, solvents, and blasting material at SWMU 106. Petroleum hydrocarbons and products of incomplete combustion are the materials of concern at AOC 603. Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area may support following base closure.

Previous Investigations

A summary of investigative activities performed at SWMU 106/AOC 603 is presented in Table 4.23.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report*.

Table 4.23.2
Summary of SWMU 106/AOC 603 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	Site soil and groundwater investigation. ***Round 1*** **Soil:** 7 surface borings (0 to 1 foot) 7 subsurface borings (3 to 5 feet) (106SB001): VOCs, SVOCs, metals, cyanide, pesticides, PCBs, pH, and organotins (106002 - 106SB003; 603SB001 – 603SB004): VOCs, SVOCs, metals, cyanide, pesticides, PCBs, and organotins	***Round 1*** **Groundwater:** 1 shallow well (106001): VOCs, SVOCs, metals, cyanide, pesticides, PCBs, chlorides, sulfates, TDS, and organotins
RFI (EnSafe)	1995-1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (106001): SVOCs, metals, chlorides, sulfates, TDS, and organotins

Table 4.23.2
Summary of SWMU 106/AOC 603 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 1 shallow well (106001): metals, chlorides, sulfates, and TDS
RFI (EnSafe)	1995-1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (106001): metals, chlorides, sulfates, and TDS

Nature and Extent of Contaminants

Approximately eight sample locations for SWMU 106/AOC 603 were collected and analyzed for various methods between 1995 and 1997. Of these eight, three sample locations were within the boundaries of Drainage Basin 40. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site attributable to possible spills occurring in the area. Chemicals of particular interest included arsenic and BEQs in surface soil and arsenic in shallow groundwater. Based on the analytical results and the human health risk assessment for the site, a CMS was recommended for groundwater at SWMU 106/AOC603.

4.23.1.2 AOC 602

Site Description and History

AOC 602 is a former electrical substation at Building 95. Constructed in 1943, Building 95 was originally used as an electrical substation for Drydock 3. It housed PCB containing transformers until renovation in 1989. The renovation was interrupted by Hurricane Hugo and the building was subsequently taken out of service. Currently this area is paved with concrete/asphalt.

In 1986, fluid samples collected from the transformer indicated PCB concentrations were less than 50 ppm. During the RFA, stains were observed on the floor. Dielectric fluid is the material of concern for AOC 602 identified in the *Draft Zone E RFI Work Plan*. Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area

may support following base closure.

To fulfill the CSI objectives for AOC 602, soil and concrete surface wipe samples were collected in accordance with the *Draft Zone E RFI Work Plan* to determine whether any contamination resulted from onsite activities.

Previous Investigations

A summary of investigative activities performed at AOC 602 is presented in Table 4.23.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Draft Zone E RFI Report.* Four concrete wipe samples were also collected and analyzed for PCBs during the investigation. No PCBs were detected in the wipe samples.

Table 4.23.3
Summary of AOC 602 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1996	Site soil investigation	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (602SB001 – 602SB003): PCBs (602SB004): VOCs and PCBs (3 duplicates collected for OP pesticides, herbicides, hexavalent chromium, and dioxins)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately eight sample locations for AOC 602 were collected and analyzed for various methods in 1995. Of these eight two sample locations were within the boundaries of Drainage Basin 40. Surface and subsurface samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site attributable to possible spills occurring in the area. The contaminants of concern in AOC 602 were PCBs 1254 and 1260.

4.23.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at catch basin 40-B on March 2, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 40 into the Cooper River. Analytical detections for sample EFF031 are presented in Table 4.23.4.

Table 4.23.4
Storm Water Effluent Sampling Results
Drainage Basin 40

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L): Reference Concentration	Screening Value (μg/L): Chronic Saltwater Screening Value	Potential COPC
40	40-B	EFF031	Aluminum	51	3,277	NL	No
			Barium	3.60	60.31	NL	No
			Calcium*	6,900	53,455	NL	No
			Copper	35	41.98	2.90	No
			Iron	74	4,134	NL	No
			Magnesium*	960	49,255	NL	No
			Manganese	5.10	74.52	NL	No
			Potassium*	770	23,678	NL	No
			Sodium*	8,100	395,333	NL	No
			Vanadium	2.90	15.59	NL	No
			Zinc	57	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.23.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 in the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 40. Table 4.23.5 summarizes the migration pathway scenarios.

Table 4.23.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 40

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes

Table 4.23.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 40

Scenario	Pathway Description	Is Pathway Complete?
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.23.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. Facility 303/303B (Dry Dock 3) according to the EBS had reported a number of POL and paint spills with the wastewater being drained to the sump, then to the Cooper River. In the EBS for facility 304, it was reported that an oil spill in excess of 7,000 gallons occurred near Facility 304 in the Cooper River. Environmental Incident Report #87-66 stated that a cleanup was performed with minimal impact to the environmental.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF031 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

There were no potential storm water effluent COPCs identified for Drainage Basin 40 that require further characterization; therefore contaminant migration pathway scenarios 1b through 1d do not require further evaluation.

4.24 Drainage Basin 41

Drainage Basin 41 encompasses approximately 6 acres within Zones E and F in the central section of the CNC. Land cover within the basin consists of approximately 25% unpaved surfaces, 25% paved surfaces, and 25% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the seven catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 41.

Figure 4-24 illustrates the area encompassing Drainage Basin 41 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.24.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are six SWMUs/AOCs that are either partially or completely within the boundary of Drainage Basin 41. The sites are listed in Table 4.24.1 with the current status of each site. Five sites were included in the Zone J data evaluation. These sites include SWMU 5 (Battery Electrolyte Treatment Area), SWMU 18 (PCB Spill Area), AOC 604 (Substation and Storage, Building 96), AOC 605 (Waste Paint Storage Area), and AOC 620 (Battery Shop, Building 68). The majority of the sites are within the boundary of Drainage Basin 41, with the exception of AOC 605 where the lower right corner is the only portion in the drainage basin boundary. SWMU 36 is partially located in Drainage Basin 41, but no sample locations are within the drainage basin boundary.

Table 4.24.1
Drainage Basin 41 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 5	Battery Electrolyte Treatment Area	Draft RFI Report; Phase I IM Work Plan; Phase II Work Plan; Phase II Work Plan Addendum
SWMU 36	Battery Shop, Building 68	Draft RFI Report, IM Work Plan Phase I, II, II
SWMU 18	PCB Spill Area	Draft RFI Report; Phase I IM Work Plan; Phase II Work Plan; Phase II Work Plan Addendum
AOC 604	Substation and Storage, Building 96	Draft RFI Report; RFI Report Addendum
AOC 605	Waste Paint Storage Area	Draft RFI Report; Phase I IM Work Plan; Phase II Work Plan; Phase II Work Plan Addendum
AOC 620	Battery Shop, Building 68	Draft RFI Report; RFI Work Plan Addendum; IM

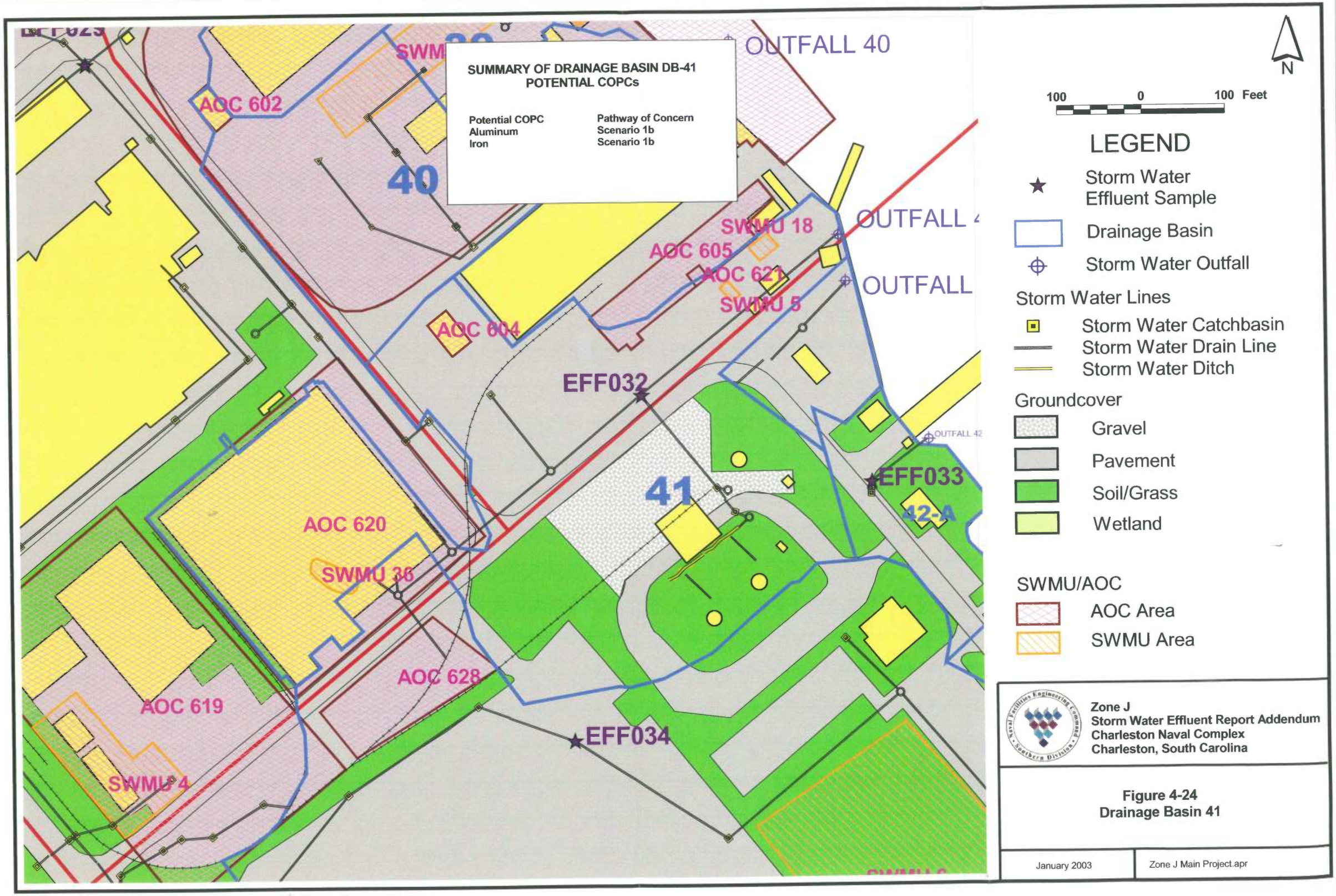

SUMMARY OF DRAINAGE BASIN DB-41
POTENTIAL COPCs
Potential COPC
Aluminum
Iron
Pathway of Concern
Scenario 1b
Scenario 1b
OUTFALL 40
AOC 602
40
SWMU 18
AOC 605
AOC 621
SWMU 5
OUTFALL
AOC 604
EFF032
41
EFF033
42-A
AOC 620
SWMU 36
AOC 628
AOC 619
EFF034
SWMU 4
N
100 0 100 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-24
Drainage Basin 41
January 2003
Zone J Main Project.apr

Table 4.24.1
Drainage Basin 41 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 621	Battery Cracking Area	Work Plan Phase I, II, II Draft RFI Report; Phase I & II Work Plan, Phase II Work Plan Addendum

4.24.1.1 SWMU 5, SWMU 18, AOC 605, AOC 621
Site Description and History

These sites were combined into one investigative unit due to their close proximity. The sites are in the southern-most portion of Zone E and are bound by Dry Dock No. 4 and the Cooper River to the north and west, River Road to the south, and Thirteenth Street to the east.

SWMU 5 is a former battery electrolyte treatment area adjacent to Pad 1278 and Dry Dock 4. Associated with battery salvaging, restoring, and recharging operations, this site was used to neutralize submarine battery acid from 1962 until 1985. It consisted of a battery disassembly platform; two USTs used for neutralization, and customized transporting railcars.

SWMU 18 is a PCB spill area at the Public Works Resource Recovery Facility Storage Area. On June 12, 1987, a contractor was loading PCB-containing items when a transformer broke and discharged Pyranol insulating fluid. The leaking transformer was placed in a drip pan, but the liquid overflowed and approximately 75 gallons of Pyranol fluid spilled onto the ground. Three soil excavations were conducted to remediate the site.

AOC 605 is a waste paint storage area adjacent to DD 4 on Pad 1278. The 40-foot x 250-foot concrete pad was constructed in 1943 as a welding area. Since 1987, the pad has been used to store materials such as paints, used oils, solvents, and chemicals. The pad is bordered to the south and west by unpaved areas.

AOC 621 comprises the battery cracking area associated with SWMUs 5 and 18 and AOC 605, which were investigated during the RFI. The unit is a concrete pad surrounded by a 1-foot-high concrete containment wall. AOC 621 was used as a welding slab from the early 1940s until around 1950. From the early 1950s to the mid 1970s this work area was used for wrecking submarine batteries, with operations including cracking batteries and draining their acids to recover lead and container cells, which were sold for scrap. A collection sump drained acid from the pad to the neutralization facility. An adjacent crane was used to move batteries around the work area. Concrete and asphalt pavement surrounded AOC 621, except for an area of soil and gravel to the southwest. Battery waste such as acids and heavy metals are the constituents of concern at this unit.

Previous Investigations

The RFI is the only investigation that has been conducted for SWMU 5, AOC 605, and AOC 621. At SWMU 18, however, the 20-foot x 20-foot spill was sampled on a 13-point grid system. Soil samples were collected following the three soil excavations. According to facility personnel, no additional excavation was required, based on analytical results, as reported in the *Final Report RCRA Facility Investigation (RFI) Charleston Naval Base* (Kemron, 1991). A summary of investigative activities is presented in Table 4.24.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone E RFI Report*.

Table 4.24.2
Summary of SWMU 5, SWMU 18, AOC 605 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil and groundwater.	
		Round 1 **Soil:** **SWMU 5** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (005SB001 – 005SB003): metals, SVOCs, VOCs, pesticides, PCBs, cyanide, organotins.	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Table 4.24.2
Summary of SWMU 5, SWMU 18, AOC 605 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		SWMU 18 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (018SB001 – 018SB004): metals, SVOCs, VOCs, pesticides, PCBs, cyanide, organotins. (1 duplicate collected for same parameters as above) **AOC 605** 11 surface borings (0 to 1 foot) (605SB001 – 605SB011): metals, SVOCs, VOCs, pesticides, PCBs, cyanide, organotins 7 subsurface borings (3 to 5 feet) (605SB002, 605SB005, 605SB006, 605SB008-605SB011): metals, SVOCs, VOCs, pesticides, PCBs, cyanide, organotins	
RFI (EnSafe)	1996	***Round 2*** **Soil:** **AOC 605** 5 surface borings (0 to 1 foot) (605SB012-605SB015, 605SB017): metals, SVOCs, VOCs, pesticides, PCBs, cyanide, organotins 1 free product sample (605FP016): SVOCs, VOCs, PCBs 4 subsurface borings (3 to 5 feet) (605SB012, 605SB014, 605SB015, 605SB017): metals, SVOCs, VOCs, pesticides, PCBs, cyanide, organotins	***Round 2*** **Groundwater:** **SWMU 18/AOC 605** 5 shallow wells (018001, 018002, 605001 – 605003), Four rounds of data (1996 – 1997): metals, SVOCs, VOCs, pesticides, PCBs, cyanide.
RFI (EnSafe)	1996	***Round 3*** **AOC 605** 5 surface boring (0 to 1 foot) (605SB012-605SB017): metals, SVOCs, VOCs, pesticides, PCBs, cyanide, organotins 4 subsurface boring (3 to 5 feet) (605SB012, 605SB014-605SB017): metals, SVOCs, VOCs, pesticides, PCBs, cyanide, organotins	***Round 3*** **Groundwater:** No Groundwater Samples Collected.
RFI Addendum (EnSafe)	1999	***Round 4*** **Soil:** **AOC 621** 4 surface boring (0 to 1 foot) 3 subsurface boring (3 to 5 feet) (621SB001-621SB004): metals,	***Round 4*** **Groundwater:** No Groundwater Samples Collected.

Table 4.24.2
Summary of SWMU 5, SWMU 18, AOC 605 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		SVOCs, VOCs, pesticides, PCBs, cyanide, organotins	
RFI Addendum (EnSafe)	1999	***Round 5*** **Soil:** **AOC 621** 24 surface boring (0 to 1 foot) 24 subsurface boring (3 to 5 feet) (621SB005-621SB028): lead	***Round 5*** **Groundwater:** No Groundwater Samples Collected.
CH2M-Jones	2001	***Round 1*** **Soil:** **SWMU 5** 44 surface soil samples (005SB004-005SB047) (0 to 1 foot): metals	***Round 1*** **Groundwater:** **SWMU 18/AOC 605** 3 samples (018001-018002, 605004): metals

Nature and Extent of Contaminants

One-hundred and four sample locations associated with SWMU 5, SWMU 18, AOC 605, and AOC 621 were evaluated for the presence of contaminants between 1996 and 2001. Of the 104 locations, approximately 60 are within the boundaries of Drainage Basin 41. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the battery electrolyte treatment, PCB spill, and waste paint storage area and previous activities at the site. Of particular interest were detections of antimony, beryllium, copper, lead, zinc, and BEQs in soil, and arsenic, antimony, and lead in groundwater.

4.24.1.2 AOC 604

Site Description and History

AOC 604 is a former electrical substation at Building 96. It is bound by Dry Dock No. 3 to the north, River Road to the south, and open paved areas to the east and west. Constructed in 1946, Building 96 was originally used as an electrical substation for Dry Dock No. 4. It originally housed PCB containing transformers. The electrical items currently stored in Building 96 do not contain PCBs.

Previous Investigations

The RFI is the only investigation that has been conducted for AOC 604. A summary of investigative activities is presented in Table 4.24.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone F RFI Report.*

Table 4.24.3
Summary of AOC 604 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 - 1997	Site investigation of soil samples.	
		Round 1 **Soil**: 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (604SB001 – 604SB004): PCBs. * 1 surface and 1 subsurface sample were submitted for VOC and TPH analysis due to high organic vapor readings.	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Eight sample locations associated with AOC 604 were evaluated for the presence of contaminants in 1996 and 1997. Of the eight locations, all are within the boundaries of Drainage Basin 41. Surface, subsurface, and wipe samples were collected and analyzed for PCBs and VOCs in order to delineate the nature and extent of potential contamination attributable to the substation and previous activities at the site.

4.24.1.3 AOC 620
Site Description and History

The site area is located in Building 68, a 48,000 square foot concrete structure. From 1942 to 1952, the building was a paint and oil warehouse. From 1952, the building was used for destruction, assembly, and rebuilding of submarine batteries. Most recently, the building was used for storage and charging of large acid batteries. AOC 620 comprises all activities within Building 68 that were related to the battery shop. Materials released, stored or disposed of at the site included sulfuric

acid, lead, paint, solvents, petroleum products, and batteries.

Previous Investigations

The RFI is the only investigation that has been conducted for AOC 620. A summary of investigative activities is presented in Table 4.24.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results are presented in the *Draft Zone F RFI Report*.

Table 4.24.4
Summary of AOC 620 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater	
		Round 1 **Soil**: 6 surface boring (0 to 1 foot) (620SB001 – 620SB006): metals, pesticides, PCBs, SVOCs, VOCs 2 subsurface boring (3 to 5 feet) (620SB005-620SB006): metals, pesticides, PCBs, SVOCs, VOCs	***Round 1*** **Groundwater:** 2 shallow wells (620001-620002): pesticides, PCBs, SVOCs, VOCs
RFI (EnSafe)	1997	***Round 2, 3, and 4*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface boring (3 to 5 feet) (620SB007-620SB009): metals, pesticides, PCBs, SVOCs, VOCs	***Round 2, 3, and 4*** **Groundwater:** 2 shallow wells (620001 - 620004): metals, pesticides, PCBs, SVOCs, VOCs
RFI (EnSafe)	1998	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 2 shallow wells (620003-620004): pesticides, PCBs, SVOCs, VOCs
RFI (EnSafe)	1999	***Round6*** **Soil:** 5 surface borings (0 to 1 foot) 5 subsurface boring (3 to 5 feet) (620SB010-620SB014): metals, pesticides, PCBs	***Round 6*** **Groundwater:** No Groundwater Samples Collected.
CH2M-Jones	2001	***Round 1*** **Soil:** 7 surface borings (0 to 1 foot) 7 subsurface boring (3 to 5 feet) (620SB015-620SB021): metals, SVOCs, VOCs	***Round 1*** **Groundwater:** 1 shallow well (620004): metals, pesticides, PCBs

Table 4.24.4
Summary of AOC 620 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CH2M-Jones	2001	***Round 2*** **Soil:** 46 surface boring (0 to 1 foot) (620SB022-620SB067): lead	***Round 2*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Seventy one sample locations associated with AOC 620 were evaluated for the presence of contaminants between 1996 and 1997. Of the 71 locations, 14 are within the boundaries of Drainage Basin 41. Surface, subsurface, and wipe samples were collected and analyzed for pesticides, PCBs, SVOCs and VOCs in order to delineate the nature and extent of potential contamination attributable to the substation and previous activities at the site.

4.24.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 41-A on June 18, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 41 into the Cooper River. Analytical detections for sample EFF032 are presented in Table 4.24.5.

Table 4.24.5
Storm Water Effluent Sampling Results
Drainage Basin 41

					Screening Value (μg/L)		
Drainage Basin	**Catch Basin/ Manhole ID**	**Sample ID**	**Parameter**	**Concentration (μg/L)**	**Reference Concentration**	**Chronic Saltwater Screening Value**	**Potential COPC**
41	41-A	EFF032	**Aluminum**	**4,100**	**3,277**	**NL**	**Yes**
			Barium	28	60.31	NL	No
			Calcium*	29,000	53,455.56	NL	No
			Chromium	13	13	50	No
			Cobalt	**2.10**	**2.00**	**NL**	**Yes**
			Copper	39	41.98	2.90	No
			Iron	**11,000**	**4,134**	**NL**	**Yes**
			Lead	**140**	**33.63**	**8.50**	**Yes**
			Magnesium*	30,000	49,255	NL	No
			Manganese	**160**	**74.52**	**NL**	**Yes**

Table 4.24.5
Storm Water Effluent Sampling Results
Drainage Basin 41

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
			Nickel	5.90	5.14	8.30	No
			Potassium*	14,000	23,678	NL	No
			Sodium*	250,000	395,333	NL	No
			Vanadium	15	15.59	NL	No
			Zinc	180	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.24.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 in the Storm water Effluent Evaluation Report and to determine the applicability of each scenario to Drainage Basin 41. The Zone J data evaluation resulted in three possible outcomes based on the available data present for Drainage Basin 41. Table 4.24.6summarizes the migration pathway scenarios.

Table 4.24.6
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 41

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	Yes
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.24.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. In the EBS for facility 304, it

was reported that an oil spill in excess of 7,000 gallons occurred near Facility 304 in the Cooper River. Environmental Incident Report #87-66 stated that a cleanup was performed with minimal impact to the environmental.

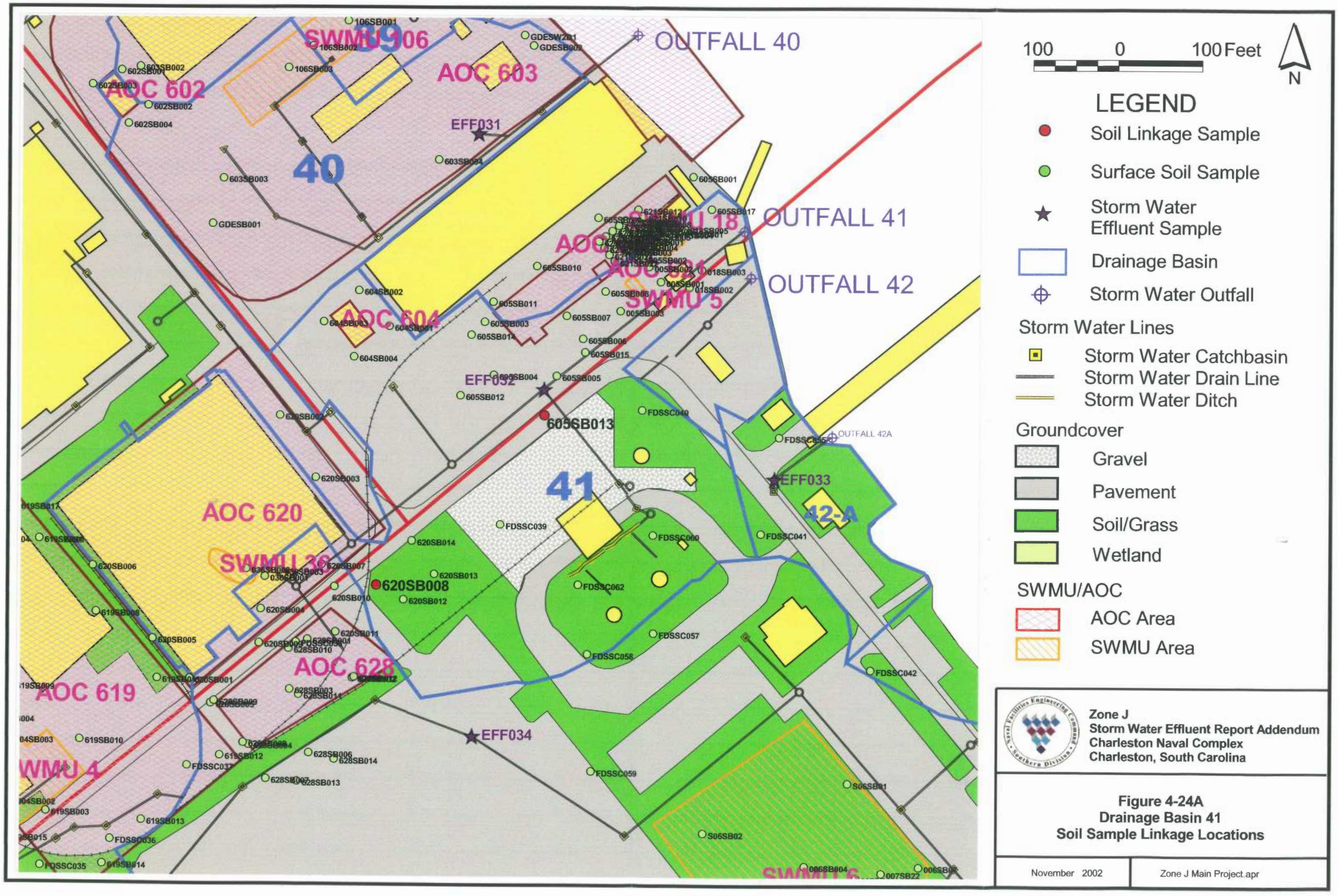
According to the EBS, Facility 325 (Pier Kilo) was the only major fueling pier at Charleston Naval Base and it was the only pier where major quantities of waste oil were unloaded from waste oil barges. From 1982 through 1991 there were 12 reported fuel oil spills totaling approximately 170 gallons in the area of the Pier Kilo that went into the river.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF032 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.24.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that at least one of seven catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone E and F background concentrations and the ecological risk based screening criteria identified existing areas that have the potential to provide an upland source of aluminum, cobalt, iron, and lead in the storm sewer system. Table 4.24.7 summarizes the locations with the potential for an upland source. Figure 4-24A illustrates the locations of these potential sources. Further evaluation of potential source areas is necessary during the SLERA.



Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-24A
Drainage Basin 41
Soil Sample Linkage Locations

November 2002	Zone J Main Project.apr

Table 4.24.7
Drainage Basin 41
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Value (mg/kg)	Distance to Catch Basin#
41/A	005SB001*	Lead	338	122 (BKG)	186.8
41/A	005SB002*	Lead	10,500	122 (BKG)	189.5
41/A	005SB003*	Lead	462	122 (BKG)	128
41/A	018SB001*	Lead	404	122 (BKG)	244.3
41/A	018SB003*	Cobalt	32.3	12.8 (BKG)	233.4
41/A	018SB004*	Lead	1,960	122 (BKG)	235.6
41/A	018SB005*	Lead	680	122 (BKG)	251.2
41/A	605SB002*	Lead	1,600	122 (BKG)	192.9
41/A	605SB003*	Lead	270	122 (BKG)	104.3
41/A	605SB004*	Iron	18,400	17,420 (BKG)	60.9
41/A	605SB005*	Lead	249	122 (BKG)	20.58
41/A	605SB006*	Lead	399	122 (BKG)	73.8
41/A	605SB007*	Cobalt	27.3	12.8 (BKG)	88.9
		Iron	20,000	17,420 (BKG)	88.9
		Lead	1,190	122 (BKG)	88.9
41/A	605SB008*	Lead	460	122 (BKG)	134.8
41/A	605SB012*	Cobalt	30.6	12.8 (BKG)	98.8
		Lead	815	122 (BKG)	98.8
41/A	605SB013	Lead	627	122 (BKG)	32.9
41/A	605SB014*	Lead	123	122 (BKG)	105.7
41/A	605SB015*	Cobalt	30.1	12.8 (BKG)	63.9
		Lead	1,120	122 (BKG)	63.9
41/A	605SB017*	Lead	176	122 (BKG)	290.0
41/A	620SB008	Aluminum	21,100	17,684 (BKG)	300.9
		Iron	23,900	17,420 (BKG)	300.9

Notes:
* = Sample location is located under pavement and constituents from these locations most likely do not represent complete exposure pathways to the storm water system.

4.24.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from

surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 41 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with aluminum, cobalt, iron, lead, and manganese intercepting the storm water drainage pipeline within Drainage Basin 41.

4.24.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 41.

Information obtained from the Davis and Floyd Study, the *Zone L RFI Report,* and *Process Closure for SWMU 37 Dye Test Cross-connect Resolution in Buildings 3, 9, and 68* Completion Report (Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP) Nov, 1998) indicates that there were cross-connects present from Building 68 in Drainage Basin 41 which were subsequently eliminated prior to publication of the Completion Report. Building 68 is presently unused and is scheduled for demolition. No other cross-connects were reported from the Zone L dye test program.

4.24.4 Summary of Potential COPCs

Table 4.24.8 summarizes the potential COPCs that have been included for further characterization during the COPC Refinement process for the Cooper River for Drainage Basin 41.

Table 4.24.8
Summary of Potential COPCs
Drainage Basin 41

Potential COPC	Pathway of Concern
Aluminum	Scenario 1b
Cobalt	Scenario 1b
Iron	Scenario 1b
Lead	Scenario 1b

4.25 Drainage Basin 42A

Drainage Basin 42A encompasses approximately 0.8 acres within Zone G in the central section of the CNC. Land cover within the drainage basin consists of approximately 45% unpaved surfaces (i.e., mostly grass), 40% paved surfaces and 15% buildings. Storm water runoff within the drainage basin is directed to at least one of two catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 42A.

Figure 4-25 illustrates the area encompassing Drainage Basin 42A and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.25.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are no SWMUs/AOCs within the boundary of Drainage Basin 42A; however, due to a spill event, a storm water effluent sample was collected.

4.25.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at catch Basin 42A-A on May 18, 2002 to determine if constituents are migrating from the reported spill area associated with Drainage Basin 42A into the Cooper River. Analytical detections for sample EFF033 are presented in Table 4.25.1.

Table 4.25.1
Storm Water Effluent Sampling Results
Drainage Basin 42A

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
42A	42A-A	EFF033	Aluminum	130	3,277	NL	No
			Arsenic	5.70	6.88	36	No
			Barium	6.60	60.31	NL	No
			Calcium*	11,000	53,455	NL	No
			Chromium	1.40	13	50	No

N

50 0 50 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-25
Drainage Basin 42A

November 2002 | Zone J Main Project.apr

Table 4.25.1
Storm Water Effluent Sampling Results
Drainage Basin 42A

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Copper	**49**	**41.98**	**2.90**	**Yes**
			Iron	170	4,134	NL	No
			Lead	3.90	33.63	8.50	No
			Magnesium*	2,300	49,255	NL	No
			Manganese	6.00	74.52	NL	No
			Potassium*	1,500	23,678	NL	No
			Sodium*	19,000	395,333	NL	No
			Vanadium	5.20	15.59	NL	No
			Zinc	48	307.83	86	No
			bis(2-Ethylhexyl) phthalate	**14**	**NL**	**NL**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.25.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 42A. Table 4.25.2 summarizes the migration pathway scenarios.

Table 4.25.2
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 42A

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	No
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No

Table 4.25.2
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 42A

Scenario	Pathway Description	Is Pathway Complete?
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.25.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. No releases impacting the storm water sewer system within the boundaries of Drainage Basin 42A were discovered during review of environmental incident reports that were maintained by the former CNSY environmental office (Code 106) between the time period from 1982 until base closure in 1996, and EBS reports prepared for property transfer. Therefore, this pathway is considered incomplete.

4.25.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of two catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone G background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source of bis(2-Ethylhexyl)phthalate or copper in the storm sewer system.

4.25.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the

maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 42A were reviewed. The preliminary evaluation did not identify any groundwater contaminated with bis(2-Ethylhexyl)phthalate or copper intercepting the storm water drainage pipeline within Drainage Basin 42A.

4.25.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 42A.

4.25.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 42A due to a lack of an upland terrestrial source identification.

4.26 Drainage Basin 43

Drainage Basin 43 encompasses approximately 20.6 acres within Zone F and Zone G. The drainage basin is located in the southeast section of the CNC. Land cover within the drainage basin consists of approximately 55% paved surfaces, 40% unpaved surfaces (i.e., mostly grass), and 5% covered by buildings foundations. Most storm water runoff within the drainage basin is directed to at least one of 23 catch basins connected to storm sewer pipelines and a drainage ditch that discharge into the Cooper River at Outfall 43.

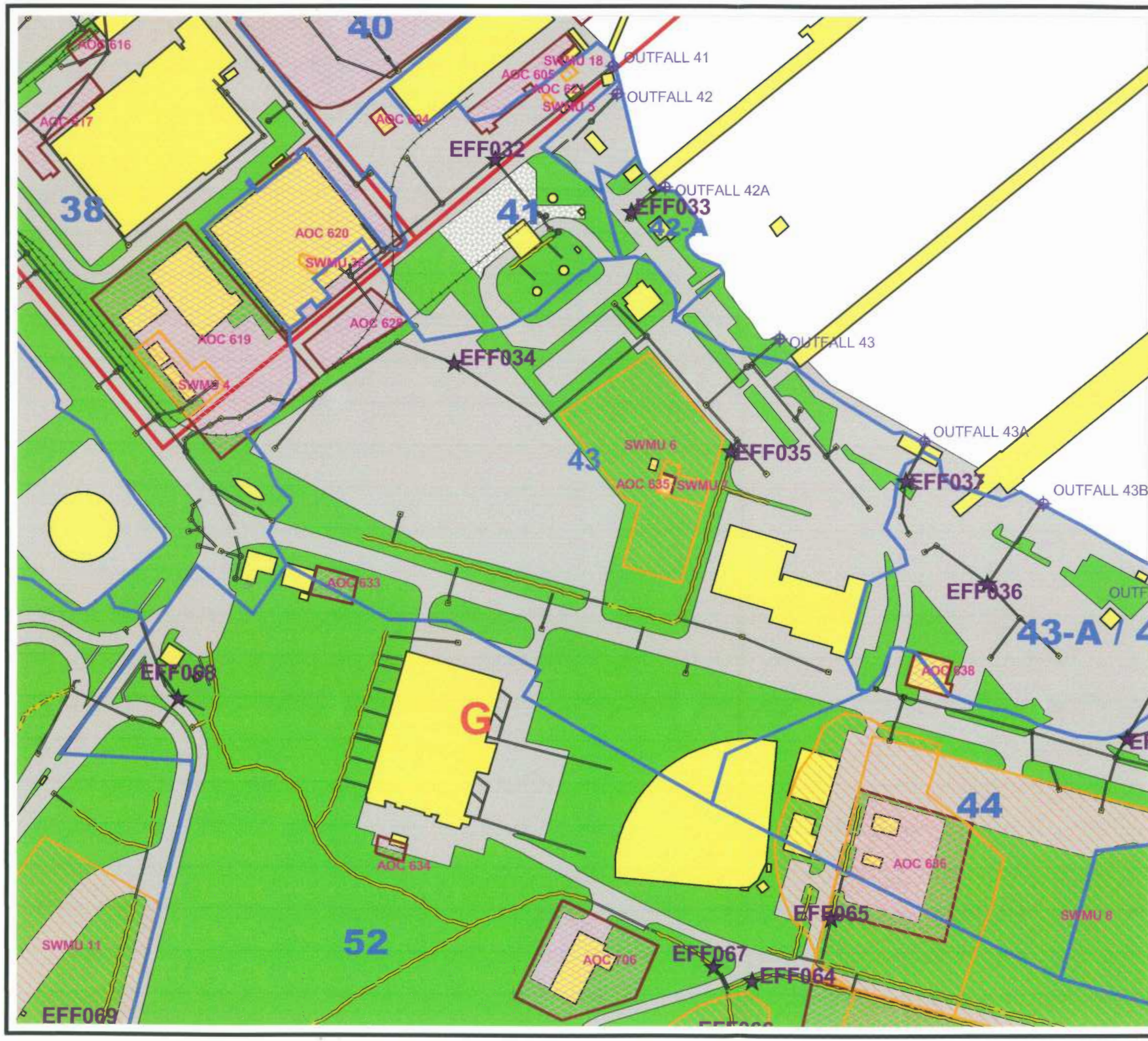
Figure 4-26 illustrates the area encompassing Drainage Basin 43 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.26.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there are nine SWMUs/AOCs that are either partially or completely within the boundary of Drainage Basin 43. The sites are listed in Table 4.26.1 along with its current status. SWMUs 6, 7 and AOCs 635 (Former Public Works Storage Yard and Building 3902) and AOC 628 (Sandblasting Area, southeast of Building 38) are completely within the boundary of Drainage Basin 43. The majority of SWMU 4 and AOC 619 (Pesticide Storage Building and Former Oil Storage Yard) are within Drainage Basin 38, and the majority of SWMU 36 and AOC 620 (Building 68, Battery Shop) are within Drainage Basin 41; however, a few sample locations transcend the boundary of Drainage Basin 43. AOC 633 (Electrical Substation, Building 451C) transcends the southern boundary into Drainage Basin 52.

Table 4.26.1
Drainage Basin 43 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 4 / AOC 619	Pesticide Storage Building and Former Oil Storage Yard	Draft RFI Report; IM; RFI Addendum Report; NFA
SWMU 36 / AOC 620	Building 68, Battery Shop	Draft RFI Report; RFI Work Plan Addendum; IM Work Plan Phase I, II, III
SWMU 6, 7 and AOC 635	Former Public Works Storage Yard and Building 3902	Draft RFI Report; Phase II Work Plan Addendum



N

200 0 200 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-26
Drainage Basin 43

November 2002 | Zone J Main Project.apr

Table 4.26.1
Drainage Basin 43 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 628	Sandblasting Area, southeast of Building 68	Draft RFI Report; IM; RFI Report Addendum
AOC 633	Electrical Substation, Building 451C	Draft RFI Report; IM Work Plan Phase I and II

4.26.1.1 SWMU 4 and AOC 619

Site Description and History

SWMU 4 and AOC 619 were combined into one investigation due to their close proximity and their potential for similar COPCs. SWMU 4 is a building used to store various insecticides and rodenticides since 1980. The building has a formulation and mixing room, and equipment wash area, and sink and floor drains connected to the base sanitary sewer system. Pesticide storage at the facility was discontinued after 1985, and afterward the building was used for miscellaneous storage only. Materials released, stored or disposed of at the facility included various pesticides. AOC 619 is a former oil storage yard used from 1955 to 1982 to store waste oil, possibly in an open pit. The possibility of an open pit storage area, along with the observation of stressed vegetation in the area was noted as increasing the potential for contamination at this site. Materials released, stored, or disposed of at this site included petroleum products.

Previous Investigations

A summary of investigative activities performed at SWMU 4 / AOC 619 is presented in Table 4.26.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone F RFI Report.*

Table 4.26.2
Summary of SWMU 4/AOC 619 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater	
		Round 1	***Round 1***
		Soil:	**Groundwater:**

Table 4.26.2
Summary of SWMU 4/AOC 619 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		19 surface samples (0 to 1 foot) 004SB001 – 004SB004 and 619SB001 – 619SB015): VOCs, SVOCs, metals, cyanide, pesticides, PCBs, OP pesticides, and herbicides (3 duplicates collected for Appendix IX analyses) 13 subsurface samples (3 to 5 feet) (004SB001, 004SB003 and 004SB004, 619SB001, 619SB003 and 619SB004, 619SB009 – 619SB015): VOCs, SVOCs, metals, cyanide, pesticides, PCBs, OP pesticides, and herbicides	3 shallow wells (619001 – 619003): VOCs, SVOCs, metals, pesticides, PCBs, and OP pesticides
RFI (EnSafe)	1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 3 shallow wells (619001 – 619003): VOCs, SVOCs, metals, pesticides, PCBs, and OP pesticides
RFI (EnSafe)	1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 3 shallow wells (619001 – 619003): VOCs, SVOCs, metals, pesticides, PCBs, and OP pesticides
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 3 shallow wells (619001 – 619003): VOCs, SVOCs, metals, pesticides, PCBs, and OP pesticides

Nature and Extent of Contaminants

Approximately 22 sample locations associated with SWMU 4 and AOC 619 were evaluated for the presence of contaminants between 1996 and 1997. Of those 22 samples, only one sample location is within the boundaries of Drainage Basin 43. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of manganese and BEQs in soil; and thallium and chloromethane in groundwater.

4.26.1.2 SWMU 36 and AOC 620

Site Description and History

SWMU 36 and AOC 620 were combined into one investigation due to their proximity and their potential for similar COPCs. The sites are located in Building 68, a 48,000 square foot concrete structure. From 1942 to 1952, the building was a paint and oil warehouse. From 1952, the building was used for destruction, assembly, and rebuilding of submarine batteries. The building was also used for storage and charging of large acid batteries. SWMU 36 is the site of two sulfuric acid releases, where acid was discharged to floor drains which had become separated from the floor, allowing the acid to drain to the soil beneath the building. AOC 620 comprises all activities within Building 68 that were related to the battery shop. Materials released, stored or disposed of at the site included sulfuric acid, lead, paint, solvents, petroleum products, and batteries.

Previous Investigations

A summary of investigative activities performed at SWMU 36 and AOC 620 is presented in Table 4.26.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone F RFI Report.*

Table 4.26.3
Summary of SWMU 36 and AOC 620 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 9 surface samples (0 to 1 foot): (036SB001 – 036SB003 and 620SB001 – 620SB006): VOCs, SVOCs, metals, pesticides, PCBs, and cyanide (2 duplicates collected for Appendix IX parameters) 3 subsurface samples (3 to 5 feet) (036SB001, 620SB005 and 620SB006): VOCs, SVOCs, metals, pesticides, and	***Round 1*** **Groundwater:** 2 shallow wells (620001 and 620002): VOCs, SVOCs, and metals

Table 4.26.3
Summary of SWMU 36 and AOC 620 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		PCBs	
RFI (EnSafe)	1997	***Round 2*** **Soil:** 3 surface soil samples (0 to 1 foot) 3 subsurface soil samples (3 to 5 feet) (620SB007 – 620SB009): SVOCs, metals, pesticides, and PCBs	***Round 2*** **Groundwater:** 4 shallow wells (620001 – 620004): VOCs, SVOCs, metals, pH
RFI (EnSafe)	1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 4 shallow wells (620001 – 620004): VOCs, SVOCs, metals, pH
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 4 shallow wells (620001 – 620004): VOCs, SVOCs, metals, pH
RFI (EnSafe)	1998	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 2 shallow wells (620003 and 620004) pH and metals
CH2M-Jones	2001	***Round 1*** **Soil:** 7 surface borings (0 to 1 foot) (620SB015 – 620SB016, 620SB019 – 620SB021): PCBs (620SB017): VOCs, SVOCs, PCBs, and metals 5 subsurface borings (3 to 5 feet) (620SB017 - 620SB018): VOCs, SVOCs, metals (620SB019 – 620SB021): PCBs	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
CH2M-Jones	2001	***Round 2*** **Soil:** 31 surface borings (0 to 1 foot) (620SB022 – 620SB046, 620SB053 – 620SB057, 620SB060): lead, mercury 27 subsurface borings (3 to 5 feet) (620SB022 – 620SB024, 620SB026 – 620SB028, 620SB032 – 620SB046, 620SB053 – 620SB057, 620SB060): lead, mercury	***Round 2*** **Groundwater:** 2 shallow wells (620002): mercury, lead (620004): lead
CH2M-Jones	2002	***Round 3*** **Soil:** 7 surface borings (0 to 1 foot) 7 subsurface borings (3 to 5 feet) (620SB061 – 620SB067): lead	***Round 3*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 61 sample locations associated with SWMU 36 and AOC 620 were evaluated for the presence of contaminants between 1996 and 2002. Of those 61 samples, approximately 21 are within the boundaries of Drainage Basin 43. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of aluminum, arsenic, chromium, and BEQs in soil, and barium and thallium in groundwater. Based on the analytical results and the human health risk assessment for the site, further investigation was recommended for both surface soil and groundwater at combined SWMU 36 and AOC 620.

4.26.1.3 SWMUs 6, 7, and AOC 635

Site Description and History

SWMUs 6 and 7 and AOC 635 were combined into one investigation due to their close proximity and their potential for similar COPCs. Known as the Public Works Storage Yard, SWMU 6 is an unpaved, open, fenced storage yard located north of Hobson Avenue, south of River Road, and Southeast of Thirteenth Street. Routinely generated containerized wastes (cleaning solvents and used motor oil from vehicle maintenance, along with wastes from building maintenance and pest control operations) were stored at this site prior to shipment offsite. The fenced area within SWMU 6 encompasses two other sites associated with activities which took place in and around Building 3902. These are SWMU 7 and AOC 635. SWMU 7 consists of Building 3902, the concrete slab adjacent the building, and the surrounding areas, which were used for storage of transformers and associated electrical equipment between 1970 and 1976. Transformers that were taken out of use were temporarily stored here prior to being shipped off base. Previous oil spills around the pad were evident during the RFA. AOC 635 consists of the paint and oil storehouse at Building 3902. The small steel storehouse was erected in 1942 on a 25 foot by 25 foot pad, and was used until 1976. Leaking transformers, old electrical equipment, paint cans and drums, used motor oil, paint solvents and plating wastes were potentially stored there. The western parking lot was also a drum storage area.

Previous Investigations

A summary of investigative activities performed at SWMUs 6 and 7 and AOC 635 is presented in Table 4.26.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone G RFI Report.*

Table 4.26.4
Summary of SWMUs 6, 7, and AOC 635 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Pre-RFI (EnSafe)	1993	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 40 surface samples (0 to 1 foot): (S06B01 – S06B07 and S06B14, S06B15, S06B20, S06B25, S06B26, B07B04 – B07B13, S07B16 – SO7B24, S07B35): VOCs, SVOCs, metals, pesticides, and PCBs (4 duplicates collected for the same parameters) 23 subsurface samples (3 to 5 feet) (S06SB02, S06B04, S06B07, S06B09, S06B12, , S06B14, S06B15, S06B17, S06B20, S06B25 – S06B29, S06B30,S06B32, S06B33, S07B11 - S07B13, S07B18, S07B22, S07B24, S07B37): VOCs, SVOCs, metals, pesticides, and PCBs (2 duplicates collected for same parameters)	***Round 1*** **Groundwater:** 7 shallow wells (006001 - 006007): VOCs, SVOCs, metals, pesticides, and PCBs
RFI (EnSafe)	1996	***Round 2*** **Soil:** 6 surface soil samples (0 to 1 foot) (006SB001 – 006SB004, 007SB001, 635SB001): VOCs, SVOCs, metals, pesticides, PCBs, herbicides, OP pesticides, dioxins, cyanide, and hexavalent chromium (2 duplicates collected for same parameters) 2 subsurface soil samples (3 to 5 feet)	***Round 2*** **Groundwater:** 7 shallow wells (006001 - 006007): VOCs, SVOCs, metals, pesticides, and PCBs

Table 4.26.4
Summary of SWMUs 6, 7, and AOC 635 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		(006SB001 and 006SB004): VOCs, SVOCs, metals, pesticides, and PCBs	
RFI (EnSafe)	1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 7 shallow wells (006001 - 006007): VOCs, SVOCs, metals, pesticides, and PCBs
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 7 shallow wells (006001 - 006007): VOCs, SVOCs, metals, pesticides, and PCBs
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 7 shallow wells (006001 - 006007): VOCs, SVOCs, metals, pesticides, and PCBs
CH2M-Jones	2001	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 1 shallow wells (006001): VOCs, SVOCs
CH2M-Jones	2002	***Round 2*** **Soil:** 11 surface borings (0 to 1 foot) (006SB005, 006SB006): PCBs (006SB007 – 006SB010, 006SB012 – 006SB015): SVOCs, pesticides, PCBs (006SB011): VOCs, SVOCs, pesticides, PCBs, metals, and cyanide 5 subsurface borings (3 to 5 feet) (006SB005): PCBs (006SB007, 006SB011, 006SB013 – 006SB014): SVOCs, pesticides, PCBs	***Round 2*** **Groundwater:** 1 shallow well (006004): SVOCs, PCBs
CH2M-Jones	2002	***Round 3*** **Soil:** 2 surface borings (0 to 1 foot) (006SB001): SVOCs, pesticides, PCBs (006SB022): PCBs 2 subsurface borings (3 to 5 feet) (006SB021): SVOCs (006SB031): metals	***Round 3*** **Groundwater:** 2 shallow well (006004, 006007): hydrazine

Nature and Extent of Contaminants

Approximately 66 sample locations associated with SWMUs 6 and 7 and AOC 635 were evaluated

for the presence of contaminants between 1993 and 2002. All 66 sample locations are within the boundaries of Drainage Basin 43. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of antimony, arsenic, thallium, Aroclor 1254, Aroclor 1260, BEQs, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and dioxin in soil; and arsenic and beryllium in groundwater. Based on the analytical results and the human health risk assessment for the site, further investigation was recommended for both soil and groundwater at combined SWMUs 6 and 7 and AOC 635.

4.26.1.4 AOC 628

Site Description and History

AOC 628 is an open area southeast of Building 68 that was used from 1962 to 1967 for abrasive blasting of large metal parts, including ship parts. At the completion of the RFA, no visible evidence of the former activities remained at the site. A high pressure fuel line runs beneath the site. Thirteenth Street and a railroad spur parallel the site area immediately to the northwest. Materials potentially released, stored or disposed of included spent blasting media, paint and metallic residues, organic solvent wastes, and petroleum products.

Previous Investigations

A summary of investigative activities performed at AOC 628 is presented in Table 4.26.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone G RFI Report.*

Table 4.26.5
Summary of AOC 628 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 5 surface samples (0 to 1 foot)	***Round 1*** **Groundwater:** No Groundwater Samples

Table 4.26.5
Summary of AOC 628 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		5 subsurface samples (3 to 5 feet) (628SB001 – 628SB005): VOCs, SVOCs, and metals	Collected.
RFI (EnSafe)	1999	***Round 2***	***Round 2***
		Soil:	**Groundwater:**
		7 surface soil samples (0 to 1 foot) (628SB006 – 628SB012): SVOCs, metals, and TOC	No Groundwater Samples Collected.
		6 subsurface soil samples (3 to 5 feet) (628SB006, 628SB008 – 620SB012): metals and TOC	
RFI (EnSafe)	2000	***Round 3***	
		Soil:	**Groundwater:**
		2 surface samples (0 to 1 foot): (628SB013 and 628SB014): SVOCs	No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 14 sample locations associated with AOC 628 were evaluated for the presence of contaminants between 1996 and 2000. All 14 sample locations are within the boundaries of Drainage Basin 43. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of arsenic, chromium, and BEQs in soil. Based on the analytical results and the human health risk assessment for the site, further investigation was recommended for soil at AOC 628.

4.26.1.5 AOC 633

Site Description and History

AOC 633 is located near Building 451C, an electrical substation built in 1943. The building is a block structure with a concrete roof and floor, several steel enclosures on concrete slabs and foundations from earlier buildings. Several high voltage switches, breakers and transformers are located in the two room block structure. In 1989, an electrical transformer at this substation was destroyed by Hurricane Hugo. Several large PCB releases have been documented from this site, including a large leak of 10C oil in 1981. No known remedial activities were known to have

occurred at this site prior to commencement of the Zone G RFI.

Previous Investigations

A summary of investigative activities performed at AOC 633 is presented in Table 4.26.6, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone G RFI Report.*

Table 4.26.6
Summary of AOC 633 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater.	
		Round 1 **Sediment:** 6 sediment samples (633M0001 – 633M0006): VOCs, SVOCs, metals, pesticides, and PCBs **Soil:** 7 surface samples (0 to 1 foot) (633SB001 – 633SB007): VOCs, SVOCs, metals, pesticides, and PCBs 5 subsurface samples (3 to 5 feet) (633SB001 - 633SB004 and 633SB007): pesticides and PCBs	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 2*** **Soil:** 3 surface soil samples (0 to 1 foot) 3 subsurface soil samples (3 to 5 feet) (633SB008 – 633SB010): pesticides and PCBs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1999	***Round 3*** **Soil:** 8 surface soil samples (0 to 1 foot) (633SB011, 633SB013 – 633SB020): metals, pesticides and PCBs 8 subsurface soil samples (3 to 5 feet) (633SB011 – 633SB015, 633SB017 – 633SB020): metals, pesticides and PCBs	***Round 3*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1999	***Round 4*** **Soil:** 1 surface soil sample (0 to 1 foot) (633SB021): PCBs	***Round 4*** **Groundwater:** No Groundwater Samples Collected.

Table 4.26.6
Summary of AOC 633 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	2000	***Round 5*** **Soil:** 1 subsurface soil sample (3 to 5 feet) (633SB021): PCBs	***Round 5*** **Groundwater:** No Groundwater Samples Collected.
Interim Measure (Navy)	2000	***Round 6*** **Soil:** Removal of PCB-impacted soils	***Round 6*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 25 sample locations associated with AOC 633 were evaluated for the presence of contaminants between 1996 and 2000. Of those 25 samples, approximately five are within the boundaries of Drainage Basin 43. Surface, subsurface, and sediment samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. No detections of any compound were of particular interest in soil. Groundwater was not sampled as a part of this investigation.

4.26.2 Storm Water Effluent Evaluation

Two storm water effluent samples were collected to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 43 into the Cooper River. Storm water effluent sample EFF034 was collected at catch basin 43/3-C on March 2, 2002. Storm water effluent sample EFF035 was collected from an open ditch near 43/2-A on March 2, 2002. Analytical detections for both EFF034 and EFF035 are presented in Table 4.26.7.

Table 4.26.7
Storm Water Effluent Sampling Results
Drainage Basin 43

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L): Reference Concentration	Screening Value (µg/L): Chronic Saltwater Screening Value	Potential COPC
43	43/3-C	EFF034	Aluminum	440	3,277	NL	No

Table 4.26.7
Storm Water Effluent Sampling Results
Drainage Basin 43

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Arsenic	4.80	6.88	NL	No
			Barium	8.10	60.31	NL	No
			Calcium*	23,000	53,455	NL	No
			Chromium	2.40	13	50	No
			Copper	5.00	41.98	2.90	No
			Iron	520	4,134	NL	No
			Lead	2.50	33.63	8.50	No
			Magnesium*	7,100	49,255	NL	No
			Manganese	13	74.52	NL	No
			Potassium*	3,700	23,678	NL	No
			Sodium*	59,000	395,333	NL	No
			Vanadium	3.80	15.59	NL	No
			Zinc	35	307.83	86	No
43	Ditch near 43/2-A	EFF035	Aluminum	970	3,277	NL	No
			Barium	20	60.31	NL	No
			Calcium*	39,000	53,455	NL	No
			Chromium	2.30	13.00	50	No
			Copper	10	41.98	2.90	No
			Iron	710	4,134	NL	No
			Lead	6.10	33.63	8.50	No
			Magnesium*	36,000	49,255	NL	No
			Manganese	23	74.52	NL	No
			Potassium*	18,000	23,678	NL	No
			Sodium*	320,000	395,333	NL	No
			Vanadium	4.00	15.59	NL	No

Table 4.26.7
Storm Water Effluent Sampling Results
Drainage Basin 43

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Zinc	33	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.26.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 43. Table 4.26.8 summarizes the migration pathway scenarios.

Table 4.26.8
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 43

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.26.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. The EBS for Facility 3902, the old Paint and Oil Storehouse within the boundaries of the "Old Corral" off of Hobson Ave., stated that in the early 1980's PCBs from used transformers have been released to the environment and may have impacted the Cooper River via storm water runoff.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF034 and EFF035 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

There were no potential storm water effluent COPCs identified for Drainage Basin 43 that require further characterization; therefore contaminant migration pathway scenarios 1b through 1d do not require further evaluation.

4.27 Drainage Basin 43A/43B

Drainage Basin 43A/43B encompasses approximately 6 acres within Zone G. The drainage basin is located in the southeast section of the CNC. Land cover within the drainage basin consists of approximately 80% paved surfaces, 10% building foundations, and 10% unpaved surfaces (i.e. mostly grass). Storm water runoff within the basin migrates through one of nine catch basins which discharge to the Cooper River via Outfalls 43A and 43B.

Figure 4-27 illustrates the area encompassing Drainage Basin 43A/43B and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.27.1 Potential Source Areas

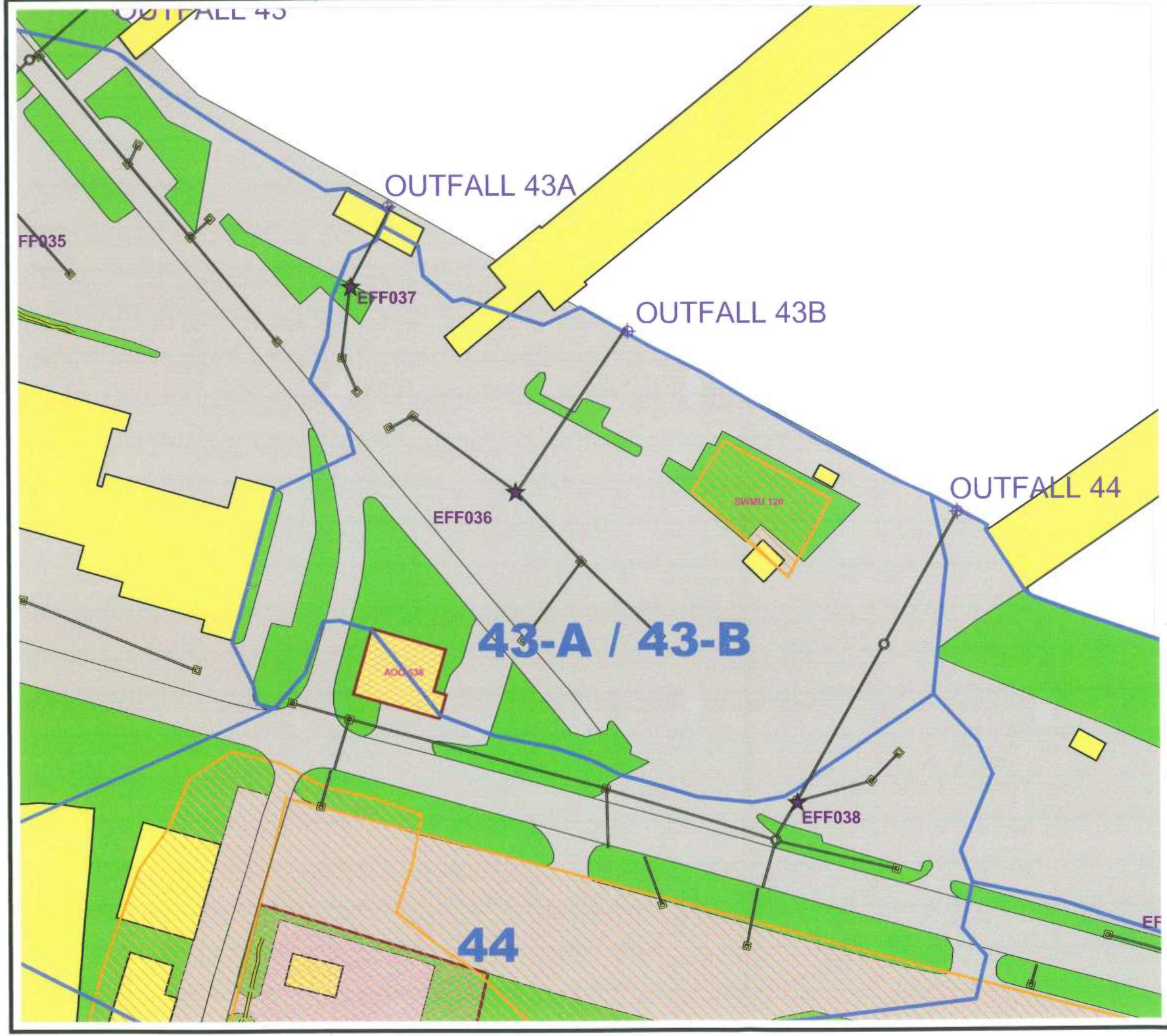
A review of the listing of sites in Appendix A of the Part B permit indicates that there is one SWMU (SWMU 120 Pier M Laydown) and one AOC (AOC 636 Torpedo Magazine, Building 161) that is partly or completely within the boundary of Drainage Basin 43A/43B. The areas investigated are listed in Table 4.27.1 along with its current status.

Table 4.27.1
Drainage Basin 43A/43B SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 120	Pier M Laydown	Draft RFI Report; RFI Report Addendum; NFA
AOC 638	Torpedo Workshop, Building 132	Draft RFI Report, RFI Report Addendum; NFA

4.27.1.1 SWMU 120
Site Description and History

SWMU 120 consists of the laydown area associated with Pier M. This consisted of an outdoor fenced storage area, and adjacent Building AS-40-1, which was a 25 foot by 40 foot paint spray booth. The building has since been torn down. The Pier M laydown was used to store palletized lead bricks and shielding, which were used by submarines. It is suspected that radiologically contaminated tarps may have also been stored there. Severe paint, grease, and solvent staining were noted in the area in the past. Materials potentially released, stored, or disposed of at the site



N

100 0 100 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-27
Drainage Basin 43A/43B

November 2002 | Zone J Main Project.apr

included lead bricks and shielding, paint/thinner wastes, and greases.

Previous Investigations

A summary of investigative activities performed at SWMU 120 is presented in Table 4.27.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone G RFI Report*.

Table 4.27.2
Summary of SWMU 120 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater to determine environmental impact	
		Round 1 **Soil:** 6 surface samples (0 to 1 foot): (120SB001 – 120SB006): VOCs, SVOCs, metals, pesticides, PCBs, cyanide 2 subsurface samples (3 to 5 feet) (120SB002 and 120SB004): VOCs, SVOCs, metals, pesticides, PCBs, cyanide on 120SB002; all but cyanide on 120SB004	***Round 1*** **Groundwater:** 3 shallow wells (120001 – 120003): VOCs, SVOCs, metals, pesticides, PCBs (1 duplicate collected for VOCs, SVOCs, metals, pesticides, PCBs, herbicides, OP pesticides, cyanide, hexavalent chromium, and dioxins)
		Sediment: 1 sediment sample (0 to 1 foot) 120M0001 VOCs, SVOCs, metals, pesticides, PCBs,	
RFI (EnSafe)	1997	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 3 shallow wells (120001 – 120003): VOCs, SVOCs, metals, pesticides, PCBs (1 duplicate collected for same analyses)
RFI (EnSafe)	1997	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 3 shallow wells (120001 – 120003): VOCs, SVOCs, metals, pesticides, PCBs (1 duplicate collected for same

Table 4.27.2
Summary of SWMU 120 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			analyses)
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 3 shallow wells (120001 – 120003): VOCs, SVOCs, metals, pesticides, PCBs (1 duplicate collected for same analyses)
RFI (EnSafe)	1999	***Round 5*** **Soil:** 6 surface samples (0 to 1 foot) 6 subsurface samples (3 to 5 feet) (120SB007 – 120SB012): SVOCs and metals	***Round 5*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	2000	***Round 6*** **Soil:** 4 surface samples (0 to 1 foot) 4 subsurface samples (3 to 5 feet) (120SB013 – 120SB016): SVOCs	***Round 6*** **Groundwater:** No Groundwater Samples Collected.
CH2M-Jones	2001	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 1 shallow well (120003): hydrazine

Nature and Extent of Contaminants

Approximately 19 sample locations associated with SWMU 120 were evaluated for the presence of contaminants between 1996 and 2001. All 19 sample locations are located within Drainage Basin 43A/43B. Surface, subsurface, sediment, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in soil; and arsenic in groundwater.

4.27.1.2 AOC 638

Site Description and History

AOC 638 is the former torpedo workshop at Building 132, which was used from 1944 until 1991. Building 132 is on the northeast corner of the intersection of Brumby Street and Hobson Avenue. From 1991 to 1995, the building was used by the Public Works Department for equipment and parts storage. The building is currently vacant.

Previous Investigations

A summary of investigative activities performed at AOC 638 is presented in Table 4.27.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone G RFI Report*.

Table 4.27.3
Summary of AOC 638 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 1 surface sample (0 to 1 foot) 1 subsurface sample (3 to 5 feet) (638SB001): SVOCs, pesticides, metals, cyanide, PCBs, VOCs, and TOC	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** 2 surface samples (0 to 1 foot) 2 subsurface samples (3 to 5 feet) (638SB003-638SB004): SVOCs, pesticides, metals, PCBs, and VOCs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 3*** **Soil:** 1 surface samples (0 to 1 foot) (638SB002): SVOCs, pesticides, metals, PCBs, VOCs	***Round 3*** **Groundwater:** 1 shallow well (638001): SVOCs, pesticides, metals, cyanide, PCBs, VOCs
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (638001): SVOCs, pesticides, metals, PCBs, VOCs
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (638001): SVOCs, pesticides, metals, PCBs, VOCs
RFI (EnSafe)	1997	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 1 shallow well (63800104): SVOCs, pesticides, metals, PCBs, VOCs

Table 4.27.3
Summary of AOC 638 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1999	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 1 shallow well (638001): SVOCs, metals, VOCs, dioxin, explosives, and hydrazine
RFI (EnSafe)	1999	***Round 8*** **Soil:** 5 surface sample (0 to 1 foot) 5 subsurface samples (3 to 5 feet) (638SB005): SVOCs, TOC (638SB006): SVOCs (638SB007-638SB009): TOC	***Round 8*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	2000	***Round 9*** **Soil:** 2 surface samples (0 to 1 foot) 2 subsurface samples (3 to 5 feet) (638SB010-638SB011): SVOCs	***Round 9*** **Groundwater:** No Groundwater Samples Collected
CH2M-Jones	2001	***Round 1*** **Soil:** 2 surface samples (0 to 1 foot) (638SB012 – 638SB013): metals	***Round 1*** **Groundwater:** 1 shallow well (638001): hydrazine

Nature and Extent of Contaminants

Approximately 14 sample locations associated with AOC 638 were evaluated for the presence of contaminants between 1996 and 2001. Of these 14, approximately 12 sample locations are within the boundaries of Drainage Basin 43A/43B. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site.

4.27.2 Storm Water Effluent Evaluation

Two storm water effluent samples was collected to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 43A/43B into the Cooper River. Sample EFF036 was collected at open grate 43A-A on May 18, 2002, and EFF037 was collected at open grates 43A-F on February 18, 2002. Analytical detections for EFF036 and EFF037 are presented in Table 4.27.4.

Table 4.27.4
Storm Water Effluent Sampling Results
Drainage Basin 43A/43B

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
43A/43B	43A-A	EFF036	Aluminum	900	3,277	NL	No
			Antimony	5.70	5.93	NL	No
			Arsenic	4.80	6.88	NL	No
			Barium	26	60.31	NL	No
			Calcium*	45,000	53,455	NL	No
			Chromium	25	13	50	No
			Copper	15	41.98	2.90	No
			Iron	2,000	4,134	NL	No
			Lead	10	33.63	8.50	No
			Magnesium*	110,000	49,255	NL	No
			Manganese	66	74.52	NL	No
			Nickel	6.10	5.14	8.30	No
			Potassium*	53,000	23,678	NL	No
			Sodium*	8,800	395,333	NL	No
			Vanadium	8.10	15.59	NL	No
			Zinc	59	307.83	86	No
43A/43B	43A-F	EFF037	Aluminum	180	3,277	NL	No
			Barium	3.80	60.31	NL	No
			Calcium*	9,300	53,455	NL	No
			Chromium	1.20	13	50	No
			Iron	280	4,134	NL	No
			Magnesium*	760	49,255	NL	No
			Manganese	12	74.52	NL	No
			Potassium*	740	23,678	NL	No
			Sodium*	8,400	395,333	NL	No

Table 4.27.4
Storm Water Effluent Sampling Results
Drainage Basin 43A/43B

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Vanadium	13	15.59	NL	No
			Zinc	17	307.83	86	No
			gamma-BHC (Lindane)	0.0095	NL	0.016	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.27.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 43A/43B. Table 4.27.5 summarizes the migration pathway scenarios.

Table 4.27.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 43A/43B

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.27.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. In 1990, two gallons of POL were released in the vicinity of Building 223 according to Environmental Incident Report #90-47. Building 223 is located within the boundaries of Drainage Basin 43A/43B, and it was not known at

the time of the release if any of the release reached the storm water sewer system. Review of the data for EFF036 and EFF037 did not identify contaminants that may be associated with residuals from the 1990 release. Therefore, this pathway is considered incomplete.

There were no potential storm water effluent COPCs identified for Drainage Basin 43A/43B that require further characterization; therefore contaminant migration pathway scenarios 1b through 1d do not require further evaluation.

4.28 Drainage Basin 44

Drainage Basin 44 encompasses approximately eight acres within Zone G, located on the southeast section of the CNC. Land cover within the drainage basin consists of approximately 40% unpaved surfaces (i.e., mostly grass), 3% buildings, and 57% paved surfaces. Storm water runoff within the basin is directed to at least one of the 12 catch basins connected to storm sewer pipelines discharging to the Cooper River via Outfall 44 or an open drainage ditch along the east side of Brumby Street. After leaving Drainage Basin 44, the ditch traverses Drainage Basins 52 and 55 to the south where it collects additional surface water runoff prior to emptying into the headwaters of Shipyard Creek.

Figure 4-28 illustrates the area encompassing Drainage Basin 44 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.28.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are three SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 44. The sites are listed in Table 4.28.1 along with their current status. These potential source areas include SWMU 8 (former Oil Sludge Pits), AOC 636 (Torpedo Magazine, Building 161 Area), and AOC 638 (former Torpedo Workshop at Building 132). For this basin assessment, note that the boundary of SWMU 8 transcends the eastern boundary of Drainage Basin 44 where it extends into Drainage Basin 45 and also the southern boundary where it extends into Drainage Basin 52. The boundary of AOC 638 also extends northward into Drainage Basin 43-A.

Table 4.28.1
Drainage Basin 44 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 8	Oil Sludge Pits, Parking Area Southwest of Building 161	Draft RFI Report; IM; CMS Work Plan
AOC 636	Torpedo Magazine, Building 161	Draft RFI Report; IM
AOC 638	Torpedo Workshop, Building 132	Draft RFI Report; RFI Report Addendum; NFA

N

100 0 100 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-28
Drainage Basin 44

November 2002 | Zone J Main Project.apr

4.28.1.1 SWMU 8 and AOC 636
Site Description and History

SWMU 8 and AOC 636 were combined into one investigative unit because of their close proximity. The sites are located in an area bound by Hobson Avenue to the north, Dyess Avenue to the south, Brumby Street to the west, and the Building X-10 compound (AOC 642) to the east. The SWMU 8 area contained three unlined pits which were used to dispose of oil sludge from 1944 to 1977. An IM, completed by the DET in September 1999, resulted in the removal of approximately 26,500 tons of oil contaminated soil and sludge. During the removal approximately 50,000 gallons of oil was skimmed from the groundwater surface in the open excavations and sent to a recycling facility. Upon completion of the IM the excavation pits were backfilled and the area covered with gravel. AOC 636 is the former torpedo magazine where subsurface disposal of unused torpedoes and munitions allegedly occurred prior to 1944 (speculative in RFA). The AOC 636 area was primarily marshlands at the time. This area has since been filled with dredged materials. The AOC 636 area currently contains Building 161 and an asphalt paved parking lot.

Previous Investigations

A summary of investigative activities performed at SMWU 8/AOC 636 is presented in Table 4.28.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone G RFI.*

Table 4.28.2
Summary of SWMU 8, AOC 636 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Confirmation Study	1982	Completed to assess potential site hazards	No information available
Soil and Groundwater Sampling	1993	Site investigation of soil and groundwater to determine environmental impact of oil sludge pits	
		Round 1 **Soil:** 31 surface borings (0 to 1 foot): (S08B01 – S08B31) VOCs, SVOCs, metals, pesticides,	***Round 1*** **Groundwater:** 6 shallow wells (008001 – 008006): VOCs, SVOCs, metals, pesticides, PCBs

Table 4.28.2
Summary of SWMU 8, AOC 636 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		PCBs, propellants, explosives 6 duplicates same analyses 15 subsurface borings (3 to 5 feet) (S08B02, S08B03, S08B12, SO8B19 – S08B28, S08B30, S08B31) VOCs, SVOCs, metals, pesticides, PCBs, propellants, explosives	
RFI (EnSafe)	1996	Site investigation of soil and groundwater to confirm soil results from 1993 investigation	
		Round 2 **Soil:** 12 surface samples (0 to 1 foot) (008SB001 – 008SB003 and 636SB001 – 636SB009): VOCs, SVOCs, metals, cyanide, pesticides, hydrazine, explosives (1 duplicate collected for same analyses) 4 subsurface borings (3 to 5 feet) (636SB002 – 636SB005): VOCs, SVOCs, metals, cyanide, pesticides, hydrazine, explosives	***Round 2*** **Groundwater:** 7 shallow wells (008001 – 008006 and 636001): VOCs, SVOCs, metals, pesticides, PCBs
Interim Measures (Navy)	1996; 1997	***Round 3*** **Soil:** Removal of oil sludge pits and pipelines (SWMU 8) and partial removal of soil at AOC 636 Numerous samples were collected to confirm the presence or absence of contaminants in the subsurface after removal of the oil sludge pits and associated piping.	***Round 3*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 4*** **Soil:** 5 surface borings (0 to 1 foot) (636SB010 – 636SB014): SVOCs, metals, and pesticides 2 subsurface samples (3 to 5 feet) (636SB013 and 636SB014): SVOCs, metals, and pesticides	***Round 4*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 5*** **Soil:** 4 surface borings (0 to 1 foot) (636SB015 – 636SB018): metals and SVOCs	***Round 5*** **Groundwater:** 6 shallow wells (008001 – 008006): explosives, PCBs, pesticides, SVOCs, VOCs, metals
RFI (EnSafe)	2000	***Round 6***	***Round 6***

Table 4.28.2
Summary of SWMU 8, AOC 636 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		Soil:	**Groundwater:**
		3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (636SB018 – 636SB020): metals	No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 61 sample locations associated with SWMU 8 and AOC 636 were evaluated for the presence of contaminants between 1993 and 1999. Of those 61, 24 sample locations are located within Drainage Basin 44. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of antimony, Arochlor 1260, arsenic, chromium, thallium, BEQs, and hydrazine in soil; and antimony, barium, thallium, vanadium, and bis(2-ethylhexyl)phthalate in groundwater.

4.28.1.2 AOC 638

Site Description and History

AOC 638 is the former torpedo workshop at Building 132, which was used from 1944 until 1991. Building 132 is on the northeast corner of the intersection of Brumby Street and Hobson Avenue. From 1991 to 1995, the building was used by the Public Works Department for equipment and parts storage.

Previous Investigations

A summary of investigative activities performed at AOC 638 is presented in Table 4.28.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone G RFI.*

Table 4.28.3
Summary of AOC 638 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 1 surface boring (0 to 1 foot) 1 subsurface boring (3 to 5 feet) (638SB001): SVOCs, pesticides, metals, cyanide, PCBs, VOCs, and TOC	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** 2 surface samples (0 to 1 foot) 2 subsurface samples (3 to 5 feet) (638SB003-638SB004): SVOCs, pesticides, metals, PCBs, and VOCs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 3*** **Soil:** 1 surface samples (0 to 1 foot) (638SB002): SVOCs, pesticides, metals, PCBs, VOCs	***Round 3*** **Groundwater:** 1 shallow well (638001): SVOCs, pesticides, metals, cyanide, PCBs, VOCs
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow well (638001): SVOCs, pesticides, metals, PCBs, VOCs
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (638001): SVOCs, pesticides, metals, PCBs, VOCs
RFI (EnSafe)	1997	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 1 shallow well (638001): SVOCs, pesticides, metals, PCBs, VOCs
RFI (EnSafe)	1999	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 1 shallow well (638001): SVOCs, metals, VOCs, dioxin, explosives, and hydrazine
RFI (EnSafe)	1999	***Round 8*** **Soil:** 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (638SB005 -638SB006): SVOCs, and metals (638SB007-638SB009): metals	***Round 8*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	2000	***Round 9*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (638SB010-638SB011): SVOCs,	***Round 9*** **Groundwater:** No Groundwater Samples Collected.

Table 4.28.3
Summary of AOC 638 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CH2M-Jones	2001	***Round 1*** **Soil:** 2 surface borings (0 to 1 foot) (638SB012 – 638SB013): metals	***Round 1*** **Groundwater:** 1 shallow well (638001): hydrazine

Nature and Extent of Contaminants

Approximately 14 sample locations associated with AOC 638 were evaluated for the presence of contaminants between 1996 and 2000. Of these 14, two sample locations are within the boundaries of Drainage Basin 44. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site.

4.28.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at catch basin 44-A1 on March 18, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 44 into the Cooper River. Analytical results for sample EFF038 are presented in Table 4.28.4.

Table 4.28.4
Storm Water Effluent Sampling Results
Drainage Basin 44

					Screening Value (µg/L)		
Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Reference Concentration	Chronic Saltwater Screening Value	Potential COPC
44	44-A1	EFF038	Aluminum	280	3,277	NL	No
			Barium	9.00	60.31	NL	No
			Calcium*	15,000	53,455	NL	No
			Copper	12	41.98	2.90	No
			Iron	260	4,134	NL	No
			Magnesium *	1,800	49,255	NL	No

Table 4.28.4
Storm Water Effluent Sampling Results
Drainage Basin 44

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Manganese	13	74.52	NL	No
			Potassium*	1,400	23,678	NL	No
			Sodium*	34,000	395,333	NL	No
			Vanadium	8.50	15.59	NL	No
			Zinc	21	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.28.3 Pathway Evaluation

There were no potential storm water effluent COPCs identified for Drainage Basin 44 that require further characterization; therefore, contaminant migration pathway scenarios (1a through 1d) do not require further evaluation.

4.29 Drainage Basin 45

Drainage Basin 45 encompasses approximately 10.8 acres within Zone G, located on the northern section of the CNC. Land cover within the drainage basin consists of approximately 10% building foundations, 25% unpaved surfaces (i.e., mostly grass) and 65% paved surfaces. Storm water runoff within the basin is directed to one of eight catch basins discharging to the Cooper River via Outfall 45.

Figure 4-29 illustrates the area encompassing Drainage Basin 45 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.29.1 Potential Source Areas

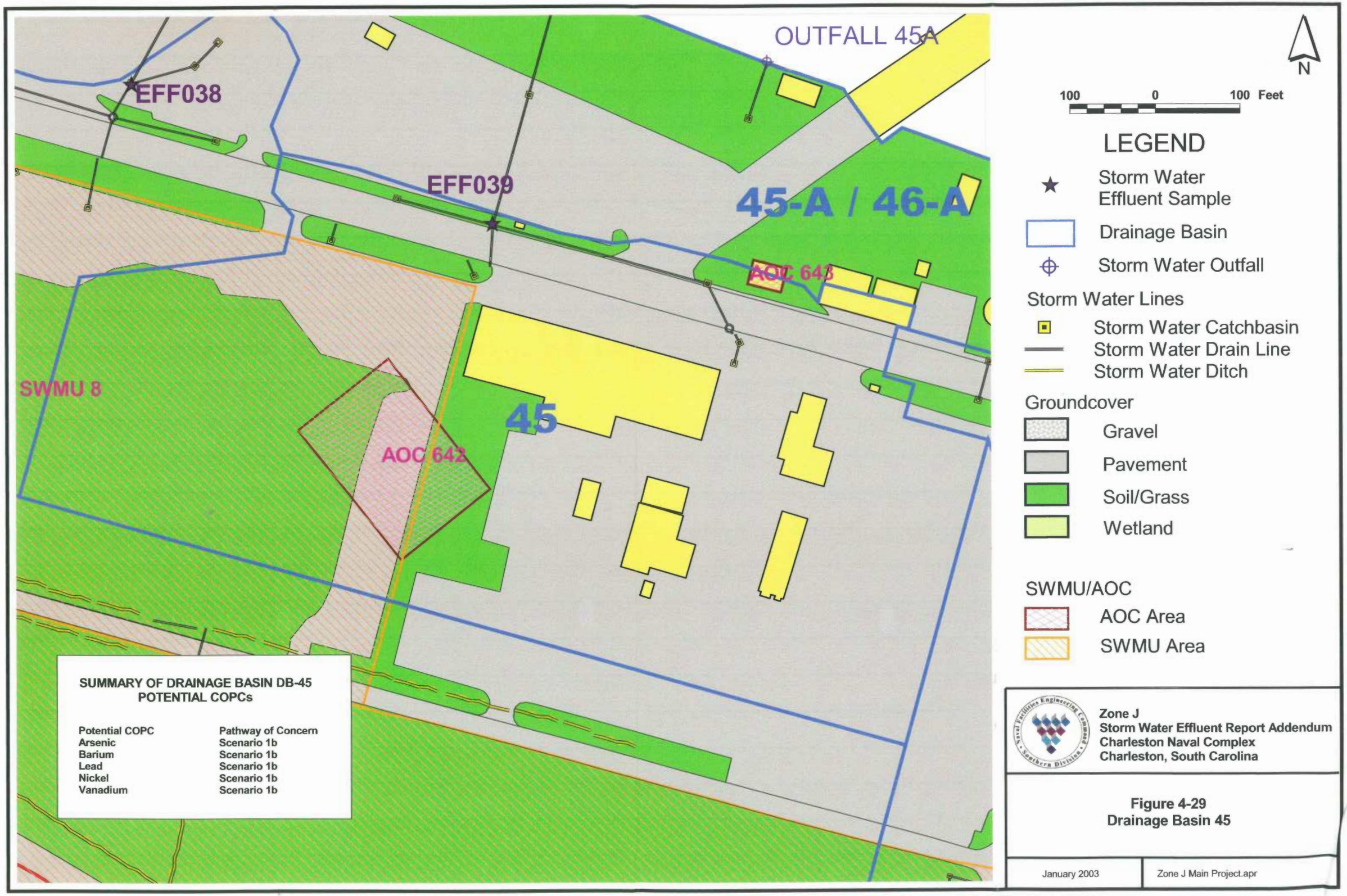
A review of the listing of sites in Appendix A of the Part B permit indicates that there are three SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 45. The sites are listed in Table 4.29.1 along with their current status. These potential source areas include SWMU 8 (Oil Sludge Pits), AOC 642 (Former Pistol Range) and AOC 643 (Substation). The boundary of AOC 642 is completely within Drainage Basin 45.

Table 4.29.1
Drainage Basin 45 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU8	Oil Sludge Pits	Draft RFI Report; IM
AOC 642	Former Pistol Range	Draft RFI Report, RFI Report Addendum, NFA
AOC 643	Substation, Building 125	Draft RFI Report, IM, RFI Report Addendum, NFA

4.29.1.1 SWMU 8
Site Description and History

SWMU 8 is located in an area bound by Hobson Avenue to the north, Dyess Avenue to the south, Brumby Street to the west, and the Building X-10 compound (AOC 642) to the east. The SWMU 8 area contained three unlined pits which were used to dispose of oil sludge from 1944 to 1977. An IM, completed by the DET in September 1999, resulted in the removal of approximately 26,500 tons


OUTFALL 45A
EFF038
EFF039
45-A / 46-A
AOC 643
SWMU 8
45
AOC 642
N
100 0 100 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
SUMMARY OF DRAINAGE BASIN DB-45
POTENTIAL COPCs
Potential COPC Pathway of Concern
Arsenic Scenario 1b
Barium Scenario 1b
Lead Scenario 1b
Nickel Scenario 1b
Vanadium Scenario 1b
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-29
Drainage Basin 45
January 2003
Zone J Main Project.apr

of oil contaminated soil and sludge. During the removal approximately 50,000 gallons of oil was skimmed from the groundwater surface in the open excavations and sent to a recycling facility. Upon completion of the IM the excavation pits were backfilled and the area covered with gravel. AOC 636 is the former torpedo magazine where subsurface disposal of unused torpedoes and munitions allegedly occurred prior to 1944 (speculative in RFA).

Previous Investigations

A summary of investigative activities performed at SMWU 8 is presented in Table 4.29.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone G RFI.*

Table 4.29.2
Summary of SWMU 8, AOC 636 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
Confirmation Study	1982	Completed to assess potential site hazards	No information available
Soil and Groundwater Sampling	1993	Site investigation of soil and groundwater to determine environmental impact of oil sludge pits	
		Round 1 **Soil:** 31 surface borings (0 to 1 foot) (S08B01 – S08B31) VOCs, SVOCs, metals, pesticides, PCBs, propellants, explosives (6 duplicates collected for same analyses) 15 subsurface borings (3 to 5 feet) (S08B02, S08B03, S08B12, S08B19 – S08B28, S08B30, S08B31): VOCs, SVOCs, metals, pesticides, PCBs, propellants, explosives	***Round 1*** **Groundwater:** 6 shallow wells (008001 – 008006): VOCs, SVOCs, metals, pesticides, PCBs
RFI (EnSafe)	1996	Site investigation of soil and groundwater to confirm soil results from 1993 investigation	
		Round 2 **Soil:** 3 surface borings (0 to 1 foot) (008SB001 – 008SB003): VOCs,	***Round 2*** **Groundwater:** 6 shallow wells (008001 – 008006): VOCs,

Table 4.29.2
Summary of SWMU 8, AOC 636 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		SVOCs, metals, cyanide, pesticides, hydrazine, explosives (1 duplicate collected for same analyses)	SVOCs, metals, pesticides, PCBs
Interim Measures (Navy)	1996; 1997	***Round 3*** **Soil:** Removal of oil sludge pits and pipelines (SWMU 8). Numerous samples were collected to confirm the presence or absence of contaminants in the subsurface after removal of the oil sludge pits and associated piping.	***Round 3*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 6 shallow wells (00800p1 – 008006): explosives, PCBs, pesticides, SVOAs, VOAs, metals.

Nature and Extent of Contaminants

Approximately 36 sample locations associated with SWMU 8 were evaluated for the presence of contaminants between 1993 and 1997. Of those 36, 16 sample locations are located within Drainage Basin 45. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of antimony, Arochlor 1260, arsenic, chromium, thallium, BEQs, and hydrazine in soil; and antimony, barium, thallium, vanadium, and bis(2-ethylhexyl)phthalate in groundwater.

4.29.1.2 AOC 642

Site Description and History

AOC 642 is the former pistol range located south of Building X-10, and west of Buildings X-12 and 1431. Hobson Avenue is to the north, while Dyess Avenue is south of the site. The site is currently a fenced, asphalt paved, parking area. The area was used as a pistol range during the 1940s. It is unknown if any spent lead bullets were removed from the site.

Based on RFI analytical results, several COCs requiring further evaluation were identified for

surface soil.

Previous Investigations

A summary of investigative activities performed at AOC 642 is presented in Table 4.29.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone G RFI.*

Table 4.29.3
Summary of AOC 642 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil.	
		Round 1 **Soil:** 10 surface borings (0 to 1 foot): metals (642SB001 – 642SB010) 1 subsurface boring (3 to 5 feet) (642SB00802): metals	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) (642SB004): TOC, cation exchange, pH	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1999	***Round 3*** **Soil:** 1 subsurface boring (3 to 5 feet) (642SB011): metals and TOC	***Round 3*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 10 sample locations associated with AOC 642 were evaluated for the presence of contaminants between 1996 and 1999. All 10 sample locations are within the boundaries of Drainage Basin 45. Surface and subsurface samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of nickel, arsenic, thallium, and manganese; however, no further investigation was recommended for this AOC.

4.29.1.3 AOC 643

Site Description and History

AOC 643 is the electric substation at Building 125, which lies on the north side of Hobson Avenue, near the entrance to Pier N. Built in 1956, the building is a 2,970 square foot, single story structure, with a concrete slab and roof. At one time, PCB transformers, inactive DC generators, switches, and circuit breakers were stored in a wooden shed adjacent to Building 125. A 1985 oil sample from a transformer inside Building 125 indicated that the unit contained PCBs. In 1988, a one-half gallon dielectric fluid spill and cleanup was documented, and stains were noted on concrete pavement around this area.

Prior to the mid-1930s, the portion of the CNC where AOC 643 is located consisted of marshland along the Cooper River. A 1909 figure of the CNC shows that the main core of buildings on the base were mostly northwest of Fifth Street, with the area south of Fifth Street mostly consisting of low-lying areas with an average elevation of about five feet mean sea level (msl). The few buildings in this area are linked by elevated causeways for foot and vehicle traffic.

A steady expansion of the base toward the southeast occurred in subsequent years, with low-lying areas being filled, and new streets and buildings being added over time. Subsequently, development continued to the southeast to an area where Wood Street marks the northwestern boundary of Zone G. Marsh was filled with hydraulic dredge material. This fill work continued with the rapid expansion of the base that occurred beginning in 1942, commensurate with America's involvement in World War II.

Expansion continued to the southeast of Viaduct Road, as well as north of Hobson Avenue to the shoreline of the Cooper River. The area southwest of the intersections of Viaduct Road and Hobson Avenue is still mostly low-lying marshland.

Previous Investigations

A summary of investigative activities performed at AOC 45 is presented in Table 4.29.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed

discussions and results are presented in the *Final Zone G RFI.*

Table 4.29.4
Summary of AOC 45 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)		Site investigation of soil.	
		Round 1 **Soil:** 6 surface borings (0 to 1 foot) 6 subsurface borings (3 to 5 feet) (643SB001 - 643SB007, except 643SB003): SVOCs, VOCs, pesticides, and PCBs (643SB001, 643SB004, and 643SB007 analyzed for metals as well)	***Round 1*** **Groundwater:** No Groundwater Samples Collected
RFI (EnSafe)		***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) 1 subsurface boring (3 to 5 feet) (643SB003): SVOCs, VOCs, pesticides, and PCBs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 3*** **Soil:** 5 surface borings (0 to 1 foot) (643SB008 - 643SB012): SVOCs, pesticides, and PCBs 5 subsurface borings (3 to 5 feet) (643SB00802 - 643SB01202: SVOCs, pesticides, and PCBs (except 643SB01002 which was analyzed for SVOCs only)	***Round 3*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 4*** **Soil:** 1 surface boring (0 to 1 foot) (643SB007): TOC, cation exchange, and pH	***Round 4*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1999	***Round 5*** **Soil:** 1 subsurface boring (3 to 5 feet) (643SB013): pesticides, metals, PCBs, and TOC	***Round 5*** **Groundwater:** No Groundwater Samples Collected.

Table 4.29.4
Summary of AOC 45 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1999	***Round 6*** **Soil:** 12 surface borings (0 to 1 foot) 11 subsurface borings (3 to 5 feet) (643SB0140): pesticides (643SB015 - 643SB017): SVOCs, metals, and TOC (643SB018 - 643SB020, 643SB022): SVOCs, PCBs, metals, and TOC (643SB023): SVOCs, pesticides, PCBs, metals, and TOC (643SB024): TOC, metals.	***Round 6*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	2000	***Round 7*** **Soil:** 5 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (643SB014): SVOCs (643SB021, 643SB025 - 643SB027): SVOCs and metals	***Round 7*** **Groundwater:** No Groundwater Samples Collected

Nature and Extent of Contaminants

Approximately 27 sample locations associated with AOC 45 were evaluated for the presence of contaminants between 1996 and 2000. Of these 27, approximately 18 sample locations are within the boundaries of Drainage Basin 45. Surface and subsurface soil samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of BEQs, arsenic, chromium, vanadium, and Aroclor-1260 in surface soil, dieldrin in subsurface soil

4.29.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at catch basin 45/1 on July 11, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 45 into the Cooper River. Analytical detections for sample EFF039 are presented in Table 4.29.5.

Table 4.29.5
Storm Water Effluent Sampling Results
Drainage Basin 45

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
45	45/1	EFF039	**Aluminum**	**16,000**	**3,277**	**NL**	**Yes**
			Antimony	**9.90**	**5.93**	**NL**	**Yes**
			Arsenic	12	6.88	36	No
			Barium	**140**	**60.31**	**NL**	**Yes**
			Beryllium	**0.88**	**0.41**	**NL**	**Yes**
			Cadmium	1.40	1.29	9.30	No
			Calcium*	290,000	53,455	NL	No
			Chromium	**62**	**13**	**50**	**Yes**
			Cobalt	**6.70**	**2.00**	**NL**	**Yes**
			Copper	**85**	**41.98**	**2.90**	**Yes**
			Iron	**16,000**	**4,134**	**NL**	**Yes**
			Lead	**110**	**33.63**	**8.50**	**Yes**
			Magnesium*	7,600	49,255	NL	No
			Manganese	**300**	**74.52**	**NL**	**Yes**
			Nickel	**31**	**5.14**	**8.30**	**Yes**
			Potassium*	6,200	23,678	NL	No
			Sodium*	270,000	395,333	NL	No
			Tin	**5.80**	**NL**	**NL**	**Yes**
			Vanadium	**64**	**15.59**	**NL**	**Yes**
			Zinc	**460**	**307.83**	**86**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.29.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent*

Evaluation Report and determine the applicability of each scenario to Drainage Basin 45. The Zone J data evaluation resulted in three possible outcomes based on the available data present for Drainage Basin 45. Table 4.29.6 summarizes the migration pathway scenarios.

Table 4.29.6
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 45

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	No
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	Yes
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.29.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. No releases impacting the storm water sewer system within the boundaries of Drainage Basin 45 were discovered during review of environmental incident reports that were maintained by the former CNSY environmental office (Code 106) between the time period from 1982 until base closure in 1996, and EBS reports prepared for property transfer. Therefore, this pathway is considered incomplete.

4.29.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of eight catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone G background concentrations and the ecological risk based screening criteria identified 14 sample

location areas illustrated in Figure 4-29A which have the potential to provide an upland identification consistent with EFF039 COPCs for entry into the storm sewer system. A summary of this evaluation is provided in Table 4.29.7.

Table 4.29.7
Drainage Basin 45
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Value (mg/kg)	Distance to Catch Basin#
45/1-C	642SB009*	Cobalt	7.70	6.60 (BKG)	216.8
		Nickel	28.6	20 (BKG)	216.8
45/1-D	643SB018	Lead	272	182 (BKG)	6.8
		Vanadium	74.4	60 (BKG)	6.8
	643SB019	Barium	198	102 (BKG)	19.5
	643SB025	Lead	307	182 (BKG)	16.5
	643SB026*	Cobalt	12.7	6.60 (BKG)	16.2
45/1-E	643SB004	Nickel	21.5	20 (BKG)	89.2
		Vanadium	141	60 (BKG)	89.2
	643SB016	Nickel	27	20 (BKG)	98.9
		Vanadium	185	60 (BKG)	98.9
	643SB017*	Cobalt	9.90	6.60 (BKG)	71.7
	643SB021*	Cobalt	32.7	6.60 (BKG)	53.3
	643SB027*	Cobalt	7.90	6.6 (BKG)	41.4
45/1-F	642SB002*	Nickel	27.6	20 (BKG)	285.5
	*642SB006	Beryllium	1.16	1.20 (BKG)	331.9
		Nickel	53.2	20 (BKG)	331.9
	*642SB007	Cobalt	17.4	6.60 (BKG)	336.3
		Nickel	253	20 (BKG)	336.3

Notes:
* = Sample location is located under pavement and constituents from these locations most likely do not represent complete exposure pathways to the storm water system.

Evaluation of surface soil data to determine possible upland terrestrial source identification with EFF039 COPCs revealed that barium, beryllium, cobalt, lead, nickel, and vanadium were detected from approximately 7 to 336 feet from catch basins within Drainage Basin 45. Therefore, the pathway is complete for the above six COPCs. Additional characterization will be required during the SLERA.

4.29.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if

constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 45 were reviewed. The preliminary evaluation identified one groundwater sample location contaminated with iron; however, iron was not detected above the screening criteria in down gradient wells. Therefore, the pathway is not considered complete for iron. There were no other detections in the groundwater consistent with EFF039 COPCs in any groundwater sample locations.

4.29.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 45.

4.29.4 Summary of Potential COPCs

Table 4.29.9 summarizes the potential COPCs that have been included for further characterization during the COPC Refinement process for the Cooper River for Drainage Basin 45.

Table 4.29.9
Summary of Potential COPCs
Drainage Basin 45

Potential COPC	Pathway of Concern
Barium	Scenario 1b
Beryllium	Scenario 1b
Cobalt	Scenario 1b
Lead	Scenario 1b
Nickel	Scenario 1b
Vanadium	Scenario 1b

100 0 100 Feet

N

LEGEND

- Soil Linkage Sample
- Surface Soil Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-29A
Drainage Basin 45
Soil Sample Linkage Locations

November 2002 | Zone J Main Project.apr

4.30 Drainage Basin 47

Drainage Basin 47 encompasses approximately 90 acres of the developed southern section of the CNC, primarily within Zone H, but also includes several acres in Zones G and I. Land cover within the basin consists of approximately 20% unpaved surfaces, 60% paved surfaces, and 20% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of 194 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 47.

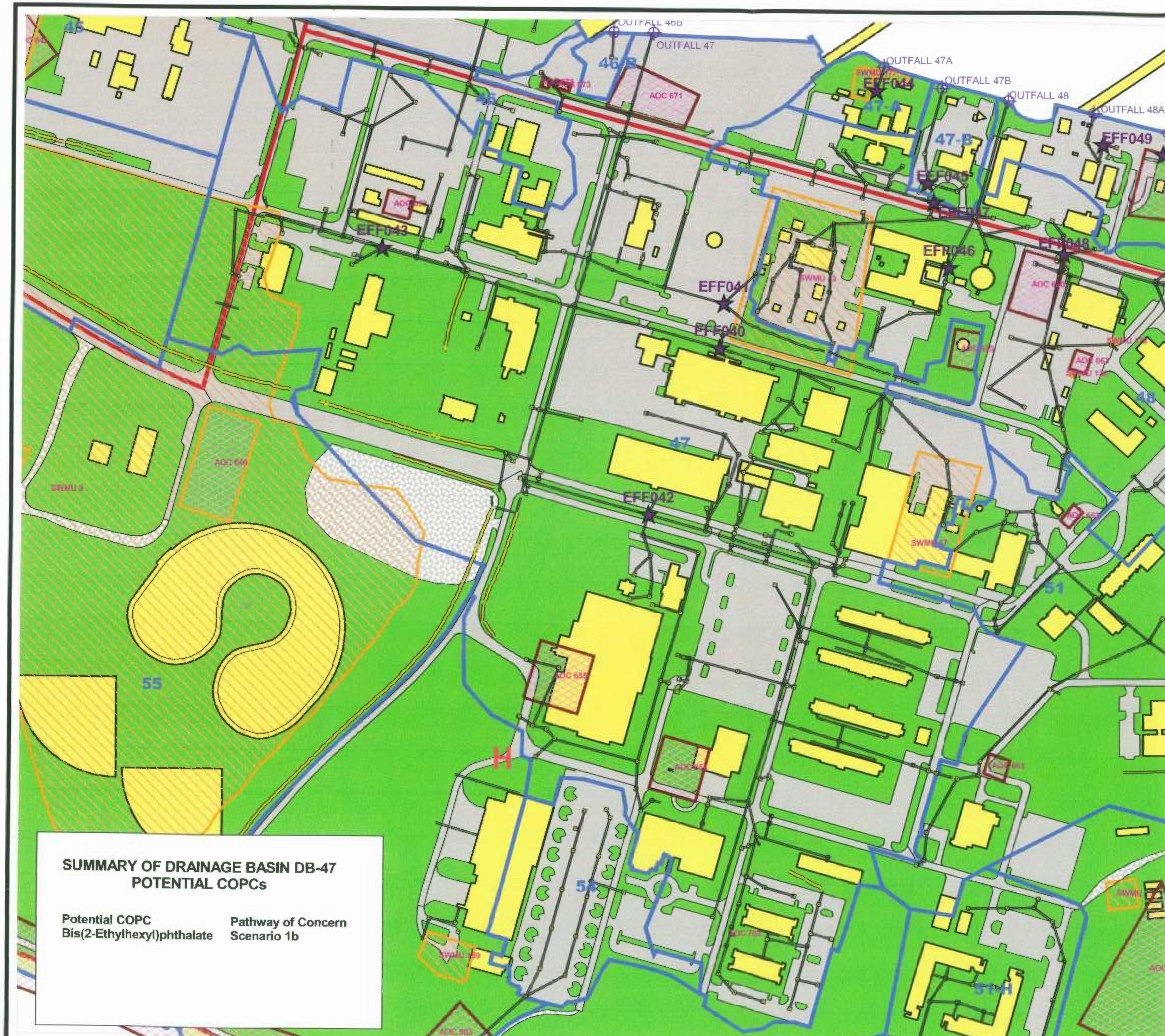
Figure 4-30 illustrates the area encompassing Drainage Basin 47 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.30.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are 11 SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 47. The sites are listed in Table 4.30.1 along with their current status. Due to their proximity to each other, AOCs 672 and 673 are assessed together. Elevated detections at two grid-based reference sample locations (G38 and G07) prompted follow-up sampling and data from the SGC event also produced data used to assess this drainage basin.

Table 4.30.1
Drainage Basin 47 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 653	Hydraulic Fuel Storage Tank, Bldg. 1508	RFI Report; IM; CMS Investigation Report Addendum
AOC 655/AOC 656	Oil Spill Area, Bldg. 656/ Petroleum Spill between Bldg. 602 and NS-71	RFI Report
AOC 659	30,000-gallon AST	RFI Report; Transferred to UST/Petroleum Storage Tank (PST) Program
AOC 671	Metering House/Gasoline Compound (Bldg. 3905G)	RFI Report; CMS Work Plan; NFA
AOC 672/AOC 673	Building 126 (Substation)/Building 169 (Paint/Oil/Solvent Storage Area)	RFI Report; CMS Work Plan; NFA
SWMU 13	Firefighter Training Area	RFI Report; Transferred to UST/PST Program
SWMU 17	Oil Spill Area (beneath fleet ballistic missile [FBM] building 61)	RFI Report; RFI Report Addendum; IM Work Plan; CMS Work Plan



SUMMARY OF DRAINAGE BASIN DB-47
POTENTIAL COPCs

Potential COPC	Pathway of Concern
Bis(2-Ethylhexyl)phthalate	Scenario 1b

N

300 0 300 Feet

LEGEND

- ★ Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Naval Facilities Engineering Command · Southern Division

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-30
Drainage Basin 47

January 2003 | Zone J Main Project.apr

Table 4.30.1
Drainage Basin 47 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
OIAs G07/G38	PCBs in soil around Zone H grid-based samples GDHSB007 (near Bldg. 644) and GDHSB038 (near Bldg. NS-84)	RFI Report

4.30.1.1 SWMU 13 and AOC 659
Site Description and History

SWMU 13, the firefighter training area for surface and submarine fleet personnel, has operated since 1973. Diesel fuel and gasoline are ignited during training in a contained, paved, and bermed area. Water and fuel drainage is directed into drains and then into oil-water separators, which drain into the sewer system. Recovered petroleum products are recycled. A UST associated with the fire fighting training area is in the northwest portion of SWMU 13.

AOC 659 is the site of a 30,000-gallon steel AST, which stored diesel fuel from 1958 to 1990. The tank, between Hobson and Dyess Avenues, is surrounded by a 5-foot-high earthen berm. Soil was sampled at AOC 659 to evaluate whether contamination is associated with the AST. For these sites, the RFI is the only investigation that has been conducted and both sites have been transferred to the UST/PST Program.

Previous Investigations

A summary of investigative activities performed at SWMU 13/AOC 659 is presented in Table 4.30.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone H RFI Report*.

Table 4.30.2
Summary of SWMU 13/AOC 659 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1994-1996	Site investigation of soil and groundwater.	
	1994	***Round 1*** **Soil:** **SWMU 13** 23 surface borings (0 to 1 foot) 17 subsurface borings (3 to 5 feet) (013SB001 – 013SB023): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH. (5 duplicates collected for herbicides, hexavalent chromium, OP pesticides, and dioxins) **AOC 659** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (659SB001 - 659SB004): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH (1 duplicate collected for herbicides, hexavalent chromium, OP pesticides, and dioxins)	***Round 1*** **Groundwater:** **SWMU 13** 9 shallow wells (013001 – 013007): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH (013G1301 – 013G1302): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH
RFI (EnSafe)	1995	***Round 2*** **Soil:** **SWMU 13** 4 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (013SB025 – 013SB028): Dioxins (2 duplicates collected for the same parameters)	***Round 2*** **Groundwater:** **SWMU 13** 9 shallow wells (013001 – 013007): SVOCs, pesticides, metals (1 duplicate collected for the same parameters) (013G1301 – 013G1302): SVOCs, pesticides, metals
RFI (EnSafe)	1995	***Round 3*** **Soil:** **SWMU 13** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (013SB18A – 013SB19A): pH, moisture, general chemistry	***Round 3*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1995	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **SWMU 13** 9 shallow wells (013001 – 013007): SVOCs, pesticides, metals (013G1301 – 013G1302): SVOCs, pesticides, metals

Table 4.30.2
Summary of SWMU 13/AOC 659 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **SWMU 13** 9 shallow wells (013001 – 013007): SVOCs, pesticides, PCBs, metals (013G1301 – 013G1302): SVOCs, pesticides, PCBs, metals

Nature and Extent of Contaminants

Approximately 42 sample locations associated with SWMU 13 /AOC 659 were evaluated for the presence of contaminants between 1994 and 1996. Of these 42, approximately 10 locations are within the boundaries of Drainage Basin 47. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the combined site. Of particular interest were detections of TPH in soil; and beryllium in groundwater. This site has been transferred to SCDHEC UST/PST program.

4.30.1.2 SWMU 17

Site Description and History

SWMU 17, approximately 0.75-acre, became a concern when an underground pipeline leading to a boiler in Building FBM 61 ruptured in 1987, releasing 14,000 gallons of fuel oil beneath the building. Approximately 0.2 acres of SWMU 17 are located in Drainage Basin 51 with Dyess Avenue bounding the site to the north, Bainbridge Avenue to the south, parking areas to the east, and Buildings 646, 646A, and 647 to the west. PCBs were also reported in soil near SWMU 17; the hydraulics/cooling system for the submarine trainers once in the building or a nearby bank of transformers (now replaced) are thought to be the source.

An IM, completed at SWMU 17 by the DET in March 1999, involved the installation of three sumps and two groundwater monitoring wells. After a year of monitoring, the IM removed approximately 45 gallons of oily PCB waste from the sumps (disposed of to a permitted facility) and generated 200 gallons of non-hazardous waste water and 110 gallons of equipment decontamination water

(disposed of to the sanitary sewer system).

Previous Investigations

A summary of investigative activities performed at SWMU 17 is presented in Table 4.30.3, which contains the date of the activities, number of soil and shallow samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone H RFI Report and Final Zone H RFI Addendum Report.*

Table 4.30.3
Summary of SWMU 17 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1994-1999	Site investigation of soil and groundwater.	
	1994	***Round 1*** **Soil:** 11 surface borings (0 to 1 foot) (017SB001 - 017SB011): VOCs, SVOCs, cyanide, metals, TPH, and pesticides, PCBs. (4 duplicates collected for herbicides, OP pesticides, hexavalent chromium, and dioxins) 9 subsurface borings (3 to 5 feet) (017SB003 – 017SB011): VOCs, SVOCs, cyanide, metals, TPH, and pesticides, PCBs	***Round 1*** **Groundwater:** 4 shallow wells (017001 – 017004): VOCs, SVOCs, cyanide, metals, TPH, and pesticides, PCBs
RFI (EnSafe)	1995	***Round 2*** **Soil:** 15 surface borings (0 to 1 foot) (017SB012 - 017SB026): SVOCs, metals, TPH, and PCBs 14 subsurface borings (3 to 5 feet) (017SB012, 017SB015 - 017SB026): SVOCs, metals, TPH, and PCBs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1995	***Round 3*** **Soil:** 8 surface borings (0 to 1 foot) 7 subsurface borings (3 to 5 feet) (017SB027 – 017SB034): Dioxins, PCBs	***Round 3*** **Groundwater:** 6 shallow wells (017001 – 017006): VOCs, SVOCs, cyanide, metals, and pesticides, PCBs (1 duplicate collected for the same parameters)
RFI (EnSafe)	1995	***Round 4*** **Soil:**	***Round 4*** **Groundwater:**

Table 4.30.3
Summary of SWMU 17 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (017SB05A – 017SB06A): pH, moisture, general chemistry	1 shallow well (017002): General chemistry
RFI (EnSafe)	1995	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 7 shallow wells (017001 – 017004, 017FP2): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH (017005 – 017006): VOCs, SVOCs, metals and general chemistry
RFI (EnSafe)	1996	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 4 shallow wells (017001 – 017004): VOCs, SVOCs, pesticides, PCBs, metals, and TPH
RFI (EnSafe)	1996	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 2 shallow wells (017005 – 017006): VOCs, SVOCs, pesticides, PCBs, metals, and Dioxins
MNA (EnSafe)	1998	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** 5 shallow wells (017002 – 017006): VOCs
RFI (EnSafe)	1998	***Round 9*** **Soil:** No Soil Samples Collected.	***Round 9*** **Groundwater:** 10 shallow wells (017001 – 017010): VOCs, SVOCs, pesticides, PCBs, and cyanide
MNA (EnSafe)	1998	***Round 10*** **Soil:** No Soil Samples Collected.	***Round 10*** **Groundwater:** 10 shallow wells (017001 – 017010): VOCs
RFI Addendum (EnSafe)	1999	***Round 11*** **Soil:** 15 surface borings (0 to 1 foot) (017SB035 – 017SB040): PCBs (017SWT01, 017SWT03): VOCs, SVOCs, PCBs (017SWL01 – 017SWL04, 017SWL06): VOCs, SVOCs, PCBs (017SWB02 – 017SWB04): VOCs, SVOCs, PCBs	***Round 11*** **Groundwater:** 16 shallow wells (017001 – 017002, 017005, 017T01 – 017T03, 017B01 - 017B02, 017B04 – 017B06, 017B08 – 017B09, 017L06, 017W03 - 017W04): VOCs, SVOCs, PCBs

Table 4.30.3
Summary of SWMU 17 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		7 surface borings (0 to 1 foot) (017SWB05 – 017SWB06, 017SWB08 – 017SWB09, 017SWD02, 017SWD04, 017SWL07): VOCs, SVOC, PCBs	
RFI Addendum (EnSafe)	2000	***Round 12*** **Soil:** No Soil Samples Collected.	***Round 12*** **Groundwater:** 10 shallow wells (017001, 017003 – 017004, 017006 – 017010, 017W01 – 017W02): VOCs
RFI (EnSafe)	2000	***Round 13*** **Soil:** No Soil Samples Collected.	***Round 13*** **Groundwater:** 2 shallow wells (017005, 017010): VOCs, SVOCs
Interim Measures (Navy)*	1998-1999	**Soil:** No Soil Samples Collected.	**Groundwater:** Installation of 3 sumps and 2 monitoring wells (017001, 017002) near building; removal of recovered fuel oil. 21 sampling events of sumps and wells over 1 year period; VOCs, SVOCs, metals, and PCBs
CH2M-Jones	2001	***Round 1*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (017SWB02, 017SWT02): VOCs, SVOCs, PCB	***Round 1*** **Groundwater:** 1 shallow well (017005): VOCs, SVOCs
CH2M-Jones	2002	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 8 shallow wells (017005 - 017006, 017008, 017011 – 017012, 017B02, 017B06, 017W02): VOCs, SVOCs, metals, general chemistry, methane, and carbon dioxide

Nature and Extent of Contaminants

Approximately 77 sample locations associated with SWMU 17 were evaluated for the presence of contaminant between 1996 and 2002. Of these 77, approximately 65 sample locations are within the boundaries of Drainage Basin 47. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential

contamination at the site. Aroclor-1260 and BEQs were identified through soil sampling and subsequent risk assessment as COCs in surface soil. Aroclor-1260 contamination was present on the west and east sides of the buildings appendage on the north side of Building 61. BEQs were present in soil samples collected from SWMU 17 at concentrations resulting in their identification as site COCs with regard to a residential scenario.

4.30.1.3 AOC 672 / AOC 673

Site Description and History

AOC 672 was an electrical substation (Building 126), built in 1947 and modified in 1950. It housed transformers and switch gear. More recent equipment was non-PCB, but previous transformers and/or switches may have contained PCB dielectric fluid or PCB-contaminated dielectric fluid. There was also a report of a transformer leak in 1981. AOC 673 is Building 169, adjacent to Building 126. It was built in 1949 and has stored paints, oils, and solvents. It also was the former site of two 25,000-gallon USTs. Both buildings are in a paved parking lot near Pier Q.

Previous Investigations

A summary of investigative activities performed at AOCs 672 and 673 is presented in Table 4.30.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone H RFI Report.*

Table 4.30.4
Summary of AOC 672/673 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil.	
		Round 1 **Soil:** 8 surface borings (0 to 1 foot) (672SB001 - 672SB004 and 673SB001 – 673SB006): VOCs, SVOCs, pesticides, PCBs, OP pesticides, metals, cyanide 6 subsurface borings (3 to 5 feet) (672SB001 – 672SB004, 673SB003,	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Table 4.30.4
Summary of AOC 672/673 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		673SB004): VOCs, SVOCs, pesticides, PCBs, OP pesticides, metals, cyanide (2 duplicates collected for Appendix IX parameters)	
RFI (EnSafe)	1995	***Round 2*** **Soil:** 1 surface borings (0 to 1 foot) (672SB003): moisture, and general chemistry	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1998	***Round 3*** **Soil:** 4 subsurface borings (3 to 5 foot) (673SB007 – 673SB010): arsenic	***Round 3*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 12 sample locations associated with AOCs 672/673 were evaluated for the presence of contaminants between 1995 and 1998. All of these 12 locations are within the boundaries of Drainage Basin 47. Surface, and subsurface samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the combined site. Of particular interest were detections of arsenic in soil.

4.30.1.4 AOC 653

Site Description and History

AOC 653 was a hydraulic fluid storage tank at the west end of Building 1508 (one of the four buildings which make up the automotive hobby shop complex). The tank is no longer in use due to suspected leakage. In addition to fluids in the tank, various paints, solvents, thinners, and petroleum products used and stored at the site may have been released.

An IM was undertaken at AOC 653 by the Environmental Detachment at Naval Base Charleston to remove the source of TPH contamination identified in soil in early 1997. Approximately 700 cubic yards of TPH-impacted soil was removed from the site. Additionally, the structure housing the hobby shop, the hydraulic lifts, and 4,500 square feet of asphalt paving was dismantled and properly disposed.

Previous Investigations

A summary of investigative activities performed at AOC 653 is presented in Table 4.30.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone I RFI.*

Table 4.30.5
Summary of AOC 653 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1994-1999	Site investigation of soil and groundwater.	
	1994	***Round 1*** **Soil:** 4 surface borings (0 to 1 foot) (653SB001 - 653SB004): VOCs, SVOCs, pesticides, PCBs metals, cyanide, and TPH (1 duplicate collected for herbicide, hexavalent chromium, dioxins, and OP pesticides) 2 subsurface borings (3 to 5 feet) (653SB001, 653SB003): VOCs, SVOCs, pesticides, PCBs metals, cyanide, TPH (1 duplicate collected for herbicide, hexavalent chromium, dioxins, and OP pesticides)	***Round 1*** **Groundwater:** 2 shallow wells (653001 and 653002): VOCs, SVOCs, pesticides, PCBs metals, cyanide, and TPH
RFI (EnSafe)	1995	***Round 2*** **Soil:** 4 surface borings (0 to 1 foot) (653SB005): Dioxins (653SB006 - 653SB008): SVOCs, pesticides, PCBs, and dioxins (1 duplicate collected for same parameters) 4 subsurface borings (3 to 5 feet) (653SB005): Dioxins (653SB006 - 653SB008): SVOCs, pesticides, PCBs, and dioxins (1 duplicate collected for same parameters)	***Round 2*** **Groundwater:** 2 shallow wells (653001 and 653002): SVOCs, pesticides, metals (1 duplicate collected for same parameters)
RFI (EnSafe)	1995	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells

Table 4.30.5
Summary of AOC 653 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			(653001 and 653002): SVOCs, pesticides, metals
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (653001 and 653002): SVOCs, pesticides, PCBs, metals, and dioxins
Interim Measures (Navy)	1997	**Soil:** 11 sidewall samples (0 to 1 foot) 653S0016, 653S0017, 653S0020 - 653S0022, 653S0024, 653S0027 - 653S0030, 653S0032): TPH 5 trench bottom samples (6 feet) (653S0018, 653S0019, 653S0023, 653S0025, 653S0026): TPH Removal of approximately 700 Cu. Yds of TPH-impacted soil	**Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1998	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 1 shallow wells (653003): VOCs
RFI (EnSafe)	1998	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow wells (653003): VOCs, metals
RFI (EnSafe)	1999	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 1 shallow wells (653003): VOCs, metals, and general chemistry
RFI (EnSafe)	1999	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 1 shallow wells (653003): VOCs, SVOCs, metals, Explosives, Dioxin, and general chemistry
CH2M-Jones	2002	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 1 shallow well (653003): hydrazine

Nature and Extent of Contaminants

Approximately 11 sample locations associated with AOC 653 were evaluated for the presence of

contaminants between 1994 and 2002. All of these 11 locations are within the boundaries of Drainage Basin 47. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the combined site. Of particular interest were detections of arsenic in soil. No concerns were identified for groundwater.

4.30.1.5 AOCs 655/656

Site Description and History

AOC 655 was the site of a 1985 No. 2 fuel oil line rupture inside Building 656. Approximately 300 gallons of a 5,800-gallon UST was released. Approximately 150 gallons of the spilled fuel was reported to have escaped through a seam in the building's concrete floor to underlying soil.

AOC 656 was the site of a 1974 oil spill between Buildings 602 and NS-71. This spill resulted from a ruptured underground line connecting an 8,000-gallon AST in Building 602 to a boiler in Building NS-71. Of the 285 gallons released during the spill, all but 10 gallons were reported to be recovered.

Previous Investigations

A summary of investigative activities performed at AOC 653 is presented in Table 4.30.6, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone I RFI.*

Table 4.30.6
Summary of AOC 655/656 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1994-1999	Site investigation of soil and groundwater.	
	1994	***Round 1*** **Soil:** **AOC 655** 9 surface borings (0 to 1 foot) (655SB001 - 655SB008,	***Round 1*** **Groundwater:** **AOC 655** 3 shallow wells (655001 – 655003): VOCs,

Table 4.30.6
Summary of AOC 655/656 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		655SSGC9): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH 4 subsurface borings (3 to 5 feet) (655SB001, 655SB003 – 655SB005): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH **AOC 656** 9 surface samples (0 to 1 foot) (656SB001 - 656SB009): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH (2 duplicates for herbicide, hexavalent chromium, OP pesticides, and dioxins) 5 subsurface samples (3 to 5 feet) (656SB001 - 656SB004, 656SB009): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH (2 duplicates for herbicide, hexavalent chromium, OP pesticides, and dioxins)	SVOCs, pesticides, PCBs, metals, cyanide, and TPH chloride, and TDS **AOC 656** 3 shallow wells (656001 – 656003): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH (1 duplicate for herbicide, hexavalent chromium, OP pesticides, and dioxins)
RFI (EnSafe)	1995	***Round 2*** **Soil:** **AOC 655** 4 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (655SB009 - 655SB010): pesticides, PCBs and TPH (2 duplicates collected for herbicide, hexavalent chromium, OP pesticides, and dioxins (655SB04A – 655SB05A): pH, moisture, and general chemistry **AOC 656** 3 surface borings (0 to 1 foot) 3 subsurface samples (3 to 5 feet) (656SB010 - 656SB011): SVOCs (656SB01A): pH, moisture, and general chemistry	***Round 2*** **Groundwater:** **AOC 655** 3 shallow wells (655001 – 655003): SVOCs, pesticides, metals **AOC 656** 3 shallow wells (656001 – 656003): SVOCs, metals, and pesticides (1 duplicate collected for same parameters)
RFI (EnSafe)	1995	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** **AOC 655** 3 shallow wells (655001 – 655003): SVOCs, metals, and pesticides (1 duplicate collected for same

Table 4.30.6
Summary of AOC 655/656 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			parameters) **AOC 656** 3 shallow wells (656001 – 656003): VOCs, metals, dioxin
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** **AOC 655** 3 shallow wells (655001 – 655003): SVOCs, pesticides, PCBs, and metals **AOC 656** 3 shallow wells (656001 – 656003): VOCs, dioxins and metals (1 duplicate collected for same parameters)
RFI (EnSafe)	1998	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** **AOC 655** 3 shallow wells (655001 – 655003): Arsenic and beryllium **AOC 656** 3 shallow wells (656001 – 656003): VOCs, dioxins
RFI (EnSafe)	1998	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** **AOC 655** 3 shallow wells (655001 – 655003): Arsenic **AOC 656** 3 shallow wells (656001 – 656003): VOCs, dioxins
RFI (EnSafe)	1999	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** **AOC 655** 3 shallow wells (655001 – 655003): metals, general chemistry **AOC 656**

Table 4.30.6
Summary of AOC 655/656 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
		3 shallow wells (656001 – 656003): Dioxins, metals, and general chemistry

Nature and Extent of Contaminants

Approximately 31 sample locations associated with AOC 653 were evaluated for the presence of contaminants between 1995 and 1999. All of these 31 locations are within the boundaries of Drainage Basin 47. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the combined site. Of particular interest were detections of arsenic in soil. No concerns were identified for groundwater.

4.30.1.6 AOC 671

Site Description and History

AOC 671 is a former metering house, Building 3905G, and two associated 25,000-gallon concrete USTs. The metering house and tanks were constructed in 1944 and used to store aviation gasoline until 1966. More recently, the area is an unused asphalt parking lot between Piers Q and R. Two raised circular areas in the asphalt are thought to represent the locations of the USTs. The lack of information documenting removal of these USTs and the surface expression suggest that the USTs are still in place. A concrete foundation along Hobson Avenue is all that remains of Building 3905G. No previous investigations or remedial actions have been documented for AOC 671.

Previous Investigations

A summary of investigative activities performed at AOC 671 is presented in Table 4.30.7, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone H RFI Report*.

Table 4.30.7
Summary of AOC 671 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995-1999	Site investigation of soil and groundwater.	
	1995	***Round 1*** **Soil:** 10 surface borings (0 to 1 foot) (671SB001 - 671SB010): VOCs, SVOCs, pesticides, PCBs, OP pesticides, metals, and cyanide 7 subsurface borings (3 to 5 feet) (671SB001 – 671SB002, 671SB004 – 671SB008): VOCs, SVOCs, pesticides, PCBs, OP pesticides, metals, and cyanide (2 duplicates collected for Appendix IX parameters and 4 duplicates collected for organotins)	***Round 1*** **Groundwater:** 4 shallow wells (671001 – 671004): VOCs, SVOCs, pesticides, PCBs, OP pesticides, metals, cyanide, sulfate, chloride, and TDS
RFI (EnSafe)	1996	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 4 shallow wells (671001 – 671004): metals, cyanide, and pesticide/PCBs
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 4 shallow wells (671001 – 671004): metals, cyanide, and pesticide/PCBs
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 4 shallow wells (671001 – 671004): metals, cyanide, pesticide/PCBs, chloride, sulfate, and TDS
RFI (EnSafe)	1999	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow wells (671003): metals, chloride, sulfate, and TDS

Nature and Extent of Contaminants

Approximately 14 sample locations associated with AOC 653 were evaluated for the presence of contaminants between 1995 and 1999. All of these 14 locations are within the boundaries of

Drainage Basin 47. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the combined site. Of particular interest were detections of arsenic in soil. No concerns were identified for groundwater.

4.30.1.7 Other Impacted Areas G07 and G38

Site Description and History

Other Impacted Areas (OIAs) G07 and G38 are areas where the Zone H grid-based soil samples GDHSB007 and GDHSB038 contained significantly high concentrations (referred to as OIA G07 and G38, based on the identifications of the grid-based soil samples). GDHSB00701 and GDHSB03801 both contained concentrations of Aroclor 1260 that were significantly higher than the risk-based screening level for that PCB, prompting the collection of supplemental samples near these grid-based sample locations to delineate the extent of Aroclor 1260 contamination.

Previous Investigations

A summary of investigative activities performed at OIAs G07 and G38 is presented in Table 4.30.8, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone H RFI Report.*

Table 4.30.8
Summary of OIA G07/G38 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil.	
		Round 1 **Soil:** **OIA G07** 2 surface borings (0 to 1 foot) (G07SB001, G07SB002): PCBs, SVOCs 2 subsurface borings (3 to 5 feet) (G07SB001 - G07SB003): PCBs, SVOCs **OIA G38**	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Table 4.30.8
Summary of OIA G07/G38 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		3 surface borings (0 to 1 foot) (G38SB001 - G38SB002): PCBs (G38SB003): PCBs, SVOCs 2 subsurface borings (3 to 5 feet) (G38SB001 - G38SB002): pesticides, PCBs	
RFI (EnSafe)	1996	***Round 2*** **Soil:** **OIA G07** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (G07SB003, G07SB004): PCBs **OIA G38** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (G38SB004 - G38SB007): PCBs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1997	***Round 3*** **Soil:** **OIA G07** 3 surface borings (0 to 1 foot) (G07SB005 - G07SB007): PCBs 1 subsurface boring (3 to 5 feet) (G07SB007): PCBs **OIA G38** 5 surface borings (0 to 1 foot) (G38SB008 - G38SB013): PCBs 1 subsurface boring (3 to 5 feet) (G38SB010): PCBs	***Round 3*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 20 sample locations associated with OIA 7 and 38 were evaluated for the presence of contaminants between 1995 and 1997. All sample locations are within the boundaries of Drainage Basin 47. Surface and subsurface soil samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of Arochlor-1260 and BEQs, specifically in surface soil, at both OIA G07 and G38. No groundwater impact was noted at these OIA.

4.30.2 Storm Water Effluent Evaluation

Four storm water effluent samples were collected to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 47 into the Cooper River. Samples were collected at catch basin 47/5/1A, open drainage ditch 47/4-D, and manhole 47/5/4 on February 8, 2002, and from manhole 47/8 on March 2, 2002. Analytical detections for EFF040, EFF041, EFF042, and EFF043 are presented in Table 4.30.9.

Table 4.30.9
Storm Water Effluent Sampling Results
Drainage Basin 47

					Screening Value (µg/L)		
Drainage Basin	**Catch Basin/ Manhole ID**	**Sample ID**	**Parameter**	**Concentration (µg/L)**	**Reference Concentration**	**Chronic Saltwater Screening Value**	**Potential COPC**
47	47/5/1A	EFF040	Aluminum	2,300	3,277	NL	No
			Barium	11	60.31	NL	No
			Calcium*	12,000	53,455	NL	No
			Chromium	6.60	13	50	No
			Iron	1,800	4,134	NL	No
			Lead	9.60	33.63	8.50	No
			Magnesium*	2,100	49,255	NL	No
			Manganese	73	74.52	NL	No
			Potassium*	1,700	23,678	NL	No
			Sodium*	6,500	395,333	NL	No
			Vanadium	8.70	15.59	NL	No
			Zinc	120	307.83	86	No
			2,4-Dimethylphenol	**0.53**	**NL**	**NL**	**Yes**
			2-Methylphenol (o-Cresol)	**0.38**	**NL**	**NL**	**Yes**
			Benzo(a)pyrene	**0.95**	**NL**	**NL**	**Yes**
			Benzo(b) fluoranthene	**1.20**	**NL**	**NL**	**Yes**
			Benzo(k) fluoranthene	**1.10**	**NL**	**NL**	**Yes**
			Bis(2-Ethylhexyl) phthalate	**1.20**	**NL**	**NL**	**Yes**
			Carbazole	**0.56**	**NL**	**NL**	**Yes**

Table 4.30.9
Storm Water Effluent Sampling Results
Drainage Basin 47

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Chrysene	**2.20**	**NL**	**NL**	**Yes**
			Fluoranthene	**4.10**	**NL**	**1.60**	**Yes**
			Phenanthrene	**2.60**	**NL**	**NL**	**Yes**
			Pyrene	**3.10**	**NL**	**NL**	**Yes**
47	47/4-D	EFF041	Aluminum	320	3,277	NL	No
			Barium	8.70	60.31	NL	No
			Calcium*	3,500	53,455	NL	No
			Chromium	2.00	13	50	No
			Iron	280	4,134	NL	No
			Lead	25	33.63	8.50	No
			Magnesium*	310	49,255	NL	No
			Manganese	8.70	74.52	NL	No
			Potassium*	300	23,678	NL	No
			Sodium*	1,600	395,333	NL	No
			Vanadium	1.90	15.59	NL	No
			2-Methylphenol (o-Cresol)	**0.90**	**NL**	**NL**	**Yes**
			Methylphenol	**0.75**	**NL**	**NL**	**Yes**
			Benzo(a)pyrene	**1.30**	**NL**	**NL**	**Yes**
			Benzo(b) fluoranthene	**1.50**	**NL**	**NL**	**Yes**
			Benzo(g,h,i) perylene	**0.75**	**NL**	**NL**	**Yes**
			Benzo(k) fluoranthene	**1.60**	**NL**	**NL**	**Yes**
			Bis(2-Ethylhexyl) phthalate	**0.62**	**NL**	**NL**	**Yes**
			Chrysene	**2.10**	**NL**	**NL**	**Yes**
			Fluoranthene	**4.10**	**NL**	**1.60**	**Yes**
			Indeno (1,2,3-c,d) pyrene	**0.62**	**NL**	**NL**	**Yes**

Table 4.30.9
Storm Water Effluent Sampling Results
Drainage Basin 47

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Phenanthrene	**2.10**	**NL**	**58**	**No**
			Pyrene	**2.60**	**NL**	**NL**	**Yes**
47	47/5/4	EFF042	Aluminum	86	3,277	NL	No
			Barium	13	60.31	NL	No
			Calcium*	14,000	53,455	NL	No
			Chromium	0.96	13	50	No
			Iron	140	4,134	NL	No
			Lead	2.70	33.63	8.50	No
			Magnesium*	25,000	49,255	NL	No
			Manganese	8.20	74.52	NL	No
			Nickel	2.60	5.14	8.30	No
			Potassium*	9,200	23,678	NL	No
			Sodium*	210,000	395,333	NL	No
			Vanadium	3.20	15.59	NL	No
			2-Methylphenol (o-Cresol)	**0.70**	**NL**	**NL**	**Yes**
			Bis(2-Ethylhexyl) phthalate	**0.69**	**NL**	**NL**	**Yes**
47	47/8	EFF043	Aluminum	140	3,277	NL	No
			Barium	5.00	60.31	NL	No
			Calcium*	9,200	53,455	NL	No
			Chromium	1.10	13	50	No
			Iron	220	4,134	NL	No
			Magnesium*	2,900	49,255	NL	No
			Manganese	16	74.52	NL	No
			Potassium*	1,700	23,678	NL	No
			Sodium*	20,000	395,333	NL	No

Table 4.30.9
Storm Water Effluent Sampling Results
Drainage Basin 47

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Vanadium	2.30	15.59	NL	No
			2,4-Dimethylphenol	**1.30**	**NL**	**NL**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.30.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the Storm Water Effluent Evaluation Report and to determine the applicability of each scenario to Drainage Basin 47. The Zone J data evaluation resulted in three possible outcomes based on the available data present for Drainage Basin 47. Table 4.30.10 summarizes the migration pathway scenarios.

Table 4.30.10
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 47

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	Yes
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.30.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS there have been several reported releases to the storm water sewer system. Listed below are the releases

and recorded dates where applicable:

- Zone Inspection Report dated July 31, 1991 for Facility 636, the former Auto Body Shop, it was reported that oil residue was noted on the ground in the vicinity of a storm drain. Approximately three gallons of oil was also found on top of the open recyclable oil tank.
- Environmental Incident Report # 87-50 reported 14,355 gallons of #5 fuel oil were released into the environment from a ruptured fuel line at Facility FBM61, the Fleet Ballistic Missile Submarine Training Center. Approximately 1,200 gallons of the fuel oil was discharged into the Cooper River via the storm water sewer system.
- The boiler waste water in Facilities NS-69, NS-71, 643, 644, 647, 648, and 657 were typically discharged to the storm water drainage system. Chemicals in the waste were caustic soda, sodium sulfite, disodium phosphate, and cyclohexylamine.

There is possible linkage evidence between historical releases and the effluent PAH data for EFF040 and EFF041. Further assessment of the data is warranted during the COPC refinement process to determine if the low concentrations of the PAHs detected in the effluent will necessitate a SLERA.

4.30.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that at least one of 194 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone H and Zone I background concentrations and the ecological risk based screening criteria did identify two sample location areas (Figure 4-30A) which have the potential to provide an upland source of bis(2-Ethylhexyl)phthalate in the storm sewer system. A summary of this evaluation is provided in Table 4.30.11.

100 0 100 Feet

N

LEGEND

- Soil Linkage Sample
- Surface Soil Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-30A
Drainage Basin 47
Soil Sample Linkage Locations

November 2002 | Zone J Main Project.apr

Table 4.30.11
Drainage Basin 47
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Value (mg/kg)	Distance to Catch Basin#
47/8/1-C	655SB005	Bis(2-Ethylhexyl)phthalate	1.80	0.182 (SSV)	15 ft.
47/12/2-C	017SB026	Bis(2-Ethylhexyl)phthalate	0.20	0.182 (SSV)	55 ft.

Notes:
= COPCs not detected within 50 foot radius of catch basin will be further characterized to reduce uncertainty

Evaluation of surface soil data to determine possible upland terrestrial source identification with EFF042 COPCs revealed that bis(2-Ethylhexyl)phthalate was detected in surface soil above screening criteria at locations within 15 feet of catch basin 47/8/1-C and 55 feet of catch basin 47/12/2-C. Therefore, the pathway is complete for the bis(2-Ethylhexyl)phthalate.

4.30.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 47 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with COPCs identified in Table 4.30.9 intercepting the storm water drainage pipeline within Drainage Basin 47.

4.30.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects

present in Drainage Basin 47.

4.30.4 Summary of Potential COPCs

Table 4.30.12 summarizes the potential COPCs that have been included for further characterization of Drainage Basin 47.

Table 4.30.12
Summary of Potential COPCs
Drainage Basin 47

Potential COPC	Pathway of Concern
Bis(2-Ethylhexyl)phthalate	Scenario 1b

4.31 Drainage Basin 47A

Drainage Basin 47A encompasses approximately 1.54 acres within Zone I in the south section of the CNC in the vicinity of Berthing Piers R and S on the Cooper River. Land cover within the drainage basin consists of approximately 70% unpaved surfaces (i.e., mostly grass), 10% paved surfaces and 20% covered by building foundations. Most storm water runoff within the drainage basin is directed to a storm sewer pipeline with one catch basin that discharges to the Cooper River via Outfall 47A. Some sheet flow from the northern portion of the drainage basin flows directly into the Cooper River.

Figure 4-31 illustrates the area encompassing Drainage Basin 47A and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.31.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there is one SWMU/AOC that is partly or completely within the boundary of Drainage Basin 47A. The site is listed in Table 4.31.1 along with its current status. This potential source area is SWMU 177/RTC, the Navy RTC.

Table 4.31.1
Drainage Basin 47A SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 177/RTC	Navy RTC	Draft RFI Report; CMS Work Plan; NFA

4.31.1.1 SWMU 177/RTC
Site Description and History

SWMU 177/RTC consisted of two adjacent buildings, both designated as RTC-4. The site is located just north of Hobson Avenue along the Cooper River in close proximity to Piers R and S. The original RTC-4 building was a 24 ft. by 60 ft. metal structure used to house heavy equipment such as backhoes and track hoes. The designation RTC-4 was given to a newer building constructed next to the former RTC-4. The newer building was used to store lawn mowers and other lawn maintenance equipment. Visual inspections during the RFA identified

N

50 0 50 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-31
Drainage Basin 47A

November 2002 | Zone J Main Project.apr

several areas of stained soil and concrete in and around the two buildings, which are less than 50 feet from the Cooper River. This resulted in the SWMU designation and the subsequent RFI. This area was included in a lease agreement between the Navy and NOAA in Spring 1995. NOAA removed both buildings and installed a diesel fuel AST and three generators.

Previous Investigations

A summary of investigative activities performed at SWMU177/RTC is presented in Table 4.31.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone I RFI Report*.

Table 4.31.2
Summary of SWMU 177/RTC Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil and groundwater	
		Round 1 **Soil:** 10 surface borings (0 to 1 foot) (RTCSB001 – RTCSB010) VOCs, SVOCs, metals, pesticides, cyanide, PCBs; (1 duplicate sample collected for above analyses and dioxins)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** 7 surface borings (0 to 1 foot) (177SB001 – 177SB007) VOCs, SVOCs, metals, pesticides, cyanide, PCBs; TPH DRO, TPH GRO, dioxins (1 duplicate collected for above analyses and herbicides, OP pesticides, hexavalent chromium) 6 subsurface samples (3 to 5 feet) (177SB002 – 177SB007) VOCs, SVOCs, metals, pesticides, OP pesticides, cyanide, PCBs; TPH DRO, TPH GRO, dioxins	***Round 2*** **Groundwater:** No Groundwater Samples Collected.

Table 4.31.2
Summary of SWMU 177/RTC Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1998	***Round 3*** **Soil:** 8 surface borings (0 to 1 foot) (177SB008 – 177SB015) VOCs and SVOCs 6 subsurface soil borings (3 to 5 feet) (177SB008-177SB009, 177SB012-177SB015) VOCS and SVOCs (1 duplicate collected for same analyses)	***Round 3*** **Groundwater:** 2 shallow wells (177001 and 177002): VOCs, SVOCs, and metals
RFI (EnSafe)	1998	***Round 4*** **Soil:** 4 surface borings (0 to 1 foot) 177SB016 – 177SB019 VOCs and SVOCs	***Round 4*** **Groundwater:** 2 shallow wells (177001 and 177002): VOCs, SVOCs, and metals
RFI (EnSafe)	1999	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 2 shallow wells (177001 and 177002): VOCs, SVOCs, and metals
RFI (EnSafe)	1999	***Round 6*** **Soil:** No Soil Samples Collected	***Round 6*** **Groundwater:** 2 shallow wells (177001 and 177002): VOCs, SVOCs, and metals

Nature and Extent of Contaminants

Approximately 31 sample locations associated with SWMU 177/RTC were evaluated for the presence of contaminants between 1995 and 1999. Twenty-six sample locations are within the boundaries of Drainage Basin 47A. Surface and subsurface soil samples and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in surface soil.

4.31.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at catch basin 47/A-A on March 2, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 47A into the Cooper River. Analytical detections for sample EFF044 are presented in Table

4.31.3.

Table 4.31.3
Storm Water Effluent Sampling Results
Drainage Basin 47A

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
44	47/A-A	EFF044	Aluminum	320	3,277	NL	No
			Barium	3.40	60.31	NL	No
			Calcium*	5,700	53,455	NL	No
			Copper	10	41.98	2.90	No
			Iron	160	4,134	NL	No
			Magnesium*	1,800	49,255	NL	No
			Manganese	4.60	74.52	NL	No
			Potassium*	4,300	23,678	NL	No
			Sodium*	9,500	395,333	NL	No
			Vanadium	1.60	15.59	NL	No
			Zinc	16	307.83	86	No
			4,4'-DDD	**0.065**	**NL**	**0.025**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.31.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 47A. Table 4.31.4 summarizes the migration pathway scenarios.

Table 4.31.4
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 47A

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	No

Table 4.31.4
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 47A

Scenario	Pathway Description	Is Pathway Complete?
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.31.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. No releases impacting the storm water sewer system within the boundaries of Drainage Basin 47A were discovered during review of environmental incident reports that were maintained by the former CNSY Environmental Office Code 106 between the time period from 1982 until base closure in 1996, and EBS reports prepared for property transfer. Therefore, this pathway is considered incomplete.

4.31.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one catch basin is near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone I background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source of 4,4'-DDD in the storm sewer system.

4.31.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 47A were reviewed. The preliminary evaluation did not identify any groundwater contaminated with 4,4'-DDD intercepting the storm water drainage pipeline within Drainage Basin 47A.

4.31.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 47A.

4.31.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 47A due to a lack of an upland terrestrial source identification.

4.32 Drainage Basin 47B

Drainage Basin 47B encompasses approximately 1.70 acres within Zone I in the southern section of the CNC. Land cover within the basin consists of approximately 20% unpaved surfaces, 60% paved surfaces, and 20% covered by building foundations. Most storm water runoff within the drainage basin is directed to at least one of the five catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 47B.

Figure 4-32 illustrates the area encompassing Drainage Basin 47B and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.32.1 Potential Source Areas

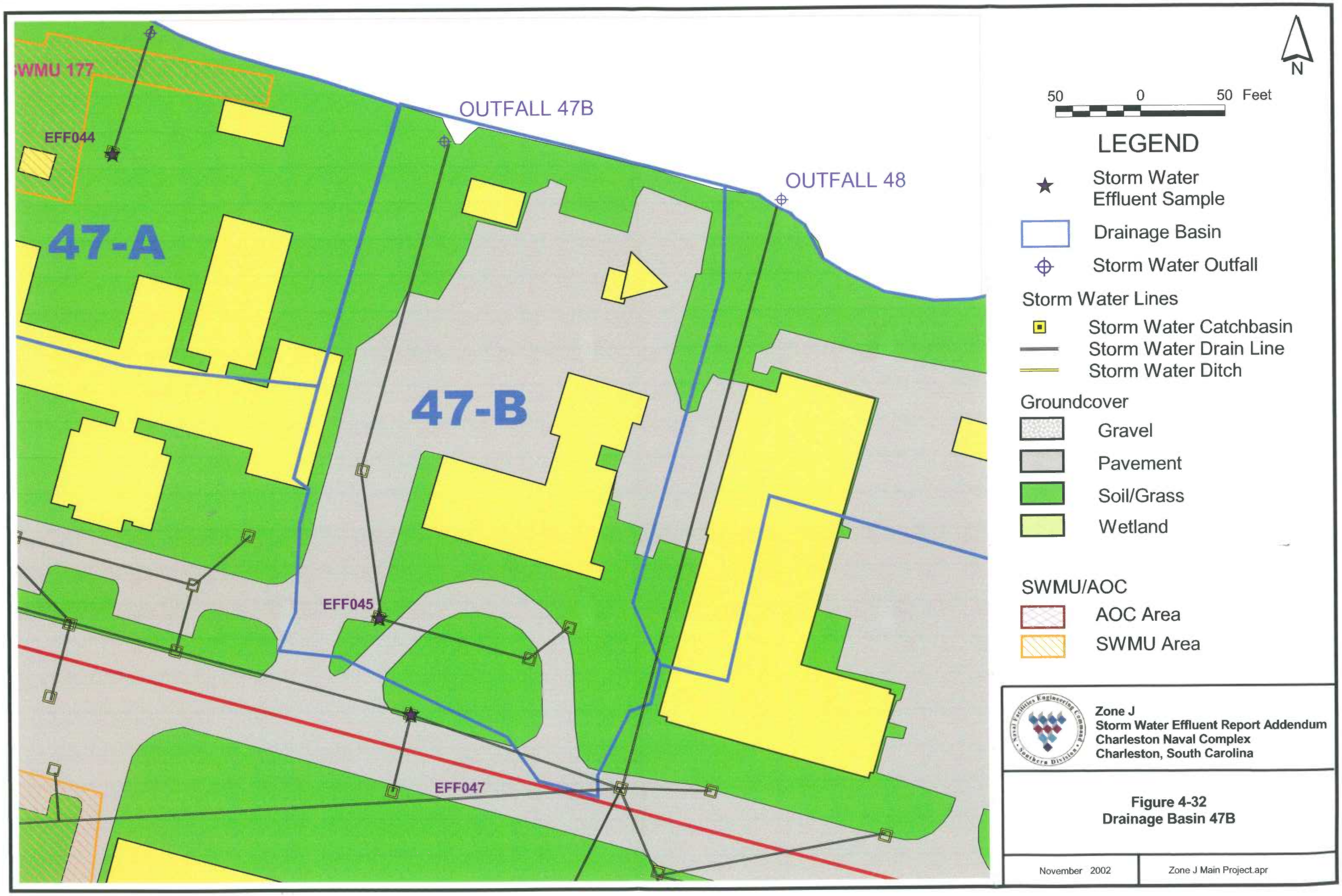
A review of the listing of sites found in Appendix A of the Part B Permit indicates there is one SWMU that is either partially or completely within the boundary of Drainage Basin 47B. The site is listed in Table 4.32.1 with the status of each site. Samples associated with SWMU 37 were collected around a sanitary sewer lift station located in Zone I. Though SWMU 37 (Sanitary Sewer investigation) is the only site within the boundary of Drainage Basin 47B, one effluent sample was collected to use as CNC background comparison if needed.

Table 4.32.1
Drainage Basin 47B SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 37	Sanitary Sewer Investigation	Draft RFI Report; NFA

4.32.1.1 SWMU 37
Site Description and History

SWMU 37 is the sanitary sewer system at CNC and included gravity pipes, manholes, lift and pumping stations, force mains, and latrines. The primary pathway for these contaminants is exfiltration into soil and groundwater to voids, cracks, and collapses of the pipes. Prior to the 1970s, CNC had a combined wastewater collection system which collected domestic wastewater, industrial wastes, and storm water runoff, which were discharged directly into the receiving watercourse without treatment. During the 1970s, a separate sanitary sewer system was


WMU 177
EFF044
OUTFALL 47B
OUTFALL 48
47-A
47-B
EFF045
EFF047
N
50 0 50 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-32
Drainage Basin 47B
November 2002
Zone J Main Project.apr

developed consisting of approximately 90,000 linear feet (LF) of gravity sewer and 29 pumping stations with associated force mains. Wastewater has entered the system from five major sources: residential areas, commercial facilities, industrial facilities, medical facilities, and naval vessels. Samples were collected for Drainage Basin 47B as part of the SWMU 37 investigation due to the presence of a sanitary sewer lift station.

Previous Investigations

A summary of investigative activities associated with Drainage Basin 47B performed at SWMU 37 is presented in Table 4.32.2., which contains the date of the activities, number of samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Zone L RFI Report*.

Table 4.32.2
Summary of SWMU 37 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1997-1998	Site soil and groundwater investigation.	
		Round 1 **Soil:** 3 surface borings (0 to 1 foot) (037SB005I – 037SB006I, 037SB008I): cyanide, metals, pesticides, SVOCs, and VOCs 2 subsurface borings (3 to 5 feet) (037SB005I, 037SB008I): cyanide, metals, pesticides, SVOCs, and VOCs	***Rounds 1-4*** **Groundwater:** 1 shallow well (037I01): cyanide, metals, pesticides, SVOCs, and VOCs

Nature and Extent of Contaminants

Approximately 4 sample locations identified during the SWMU 37 investigation are associated with Drainage Basin 47B. These locations were evaluated for the presence of contaminants between 1997 and 1998. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in soil. Based on the analytical results and the human risk assessment for the site, a CMS was recommended for soil.

4.32.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 47B-B on February 8, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 47B into the Cooper River. Analytical detections for sample EFF045 are presented in Table 4.32.3.

Table 4.32.3
Storm Water Effluent Sampling Results
Drainage Basin 47B

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L): Reference Concentration	Screening Value (μg/L): Chronic Saltwater Screening Value	Potential COPC
47B	47B-B	EFF045	Aluminum	84	3,277	NL	No
			Barium	3.30	60.31	NL	No
			Calcium*	9,300	53,455	NL	No
			Copper	5.40	41.98	2.90	No
			Iron	95	4,134	NL	No
			Magnesium*	520	49,255	NL	No
			Manganese	3.10	74.52	NL	No
			Potassium*	670	23,678	NL	No
			Sodium*	2,600	395,333	NL	No
			Vanadium	6.60	15.59	NL	No
			2-Methylphenol (o-Cesol)	**5.20**	**NL**	**NL**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.32.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 47B. Table 4.32.4 summarizes the migration pathway scenarios.

Table 4.32.4
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 47B

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system →Zone J	No

4.32.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. The boiler waste water in Facility 200 was typically discharged to the storm water drainage system. Chemicals in the waste were caustic soda, sodium sulfite, disodium phosphate, and cyclohexylamine.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF045 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.32.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of five catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone I background concentrations and the ecological risk-based screening criteria did not identify existing areas which have the potential to provide an upland source of 2-methylphenol (o-cresol) in the storm sewer system.

4.32.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 47B were reviewed. The preliminary evaluation did not identify any groundwater contaminated with 2-methylphenol (o-cresol) intercepting the storm water drainage pipeline within Drainage Basin 47B.

4.32.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 47B.

4.32.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 47B due to a lack of an upland terrestrial source identification.

4.33 Drainage Basin 48

Drainage Basin 48 encompasses approximately 27.57 acres within Zones H and I in the eastern section of the CNC near the Cooper River. Land cover within the drainage basin consists of approximately 40% unpaved surfaces (i.e., mostly grass), 50% paved surfaces, and 10% building foundations. Storm water runoff within the drainage basin is directed to one of the 67 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 48.

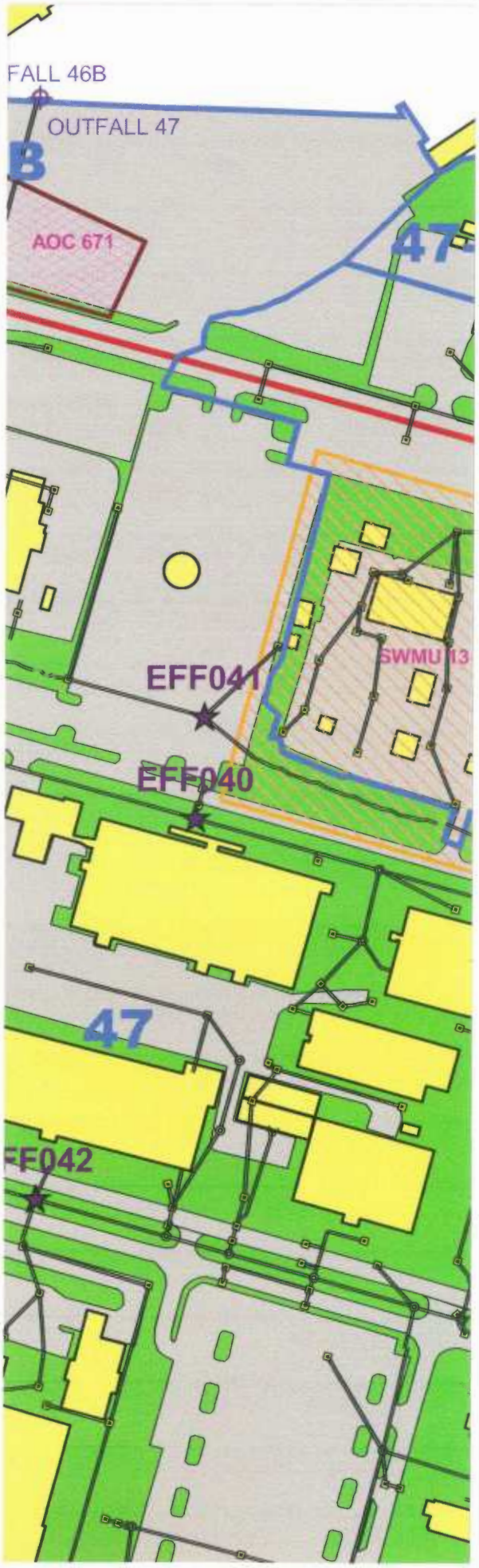
Figure 4-33 illustrates the area encompassing Drainage Basin 48 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.33.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there are seven SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 48. The sites are listed in Table 4.33.1 along with their current status. These potential source areas include SWMU 13 (Current Fire Fighter Training Area), SWMU 136 (Building NS-53 SAA), SWMU 178 (Site of Apparent Transformer Fire), AOC 660 (Mosquito Control Facility), AOC 663 (Gas/Diesel Pumping Station), AOC 665 (Pyrotechnic Storage), and AOC 679 (Former Wash Rack). For this basin assessment, note that the western and southern boundary of SWMU 13 transcends the northeastern boundary of Drainage Basin 47; however, the majority of SWMU 13 resides in Drainage Basin 48. Also, due to their proximity to each other, SWMU 136 and AOC 663 are assessed together. Elevated detections at a grid-based reference sample location (G80) prompted follow-up sampling and SGC and RTC also produced data used to assess this drainage basin.

Table 4.33.1
Drainage Basin 48 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 13	Current Fire Fighter Training Area	Draft RFI Report; Transferred to UST/PST Program
SWMU 136	Former Satellite Accumulation Area	Draft RFI Report; RFI Report Addendum Phase II; NFA
SWMU 178	Site of Apparent Transformer Fire	Draft RFI Report; Transferred to PST Program



N

200 0 200 Feet

LEGEND

Storm Water Effluent Sample

Drainage Basin

Storm Water Outfall

Storm Water Lines

Storm Water Catchbasin

Storm Water Drain Line

Storm Water Ditch

Groundcover

Gravel

Pavement

Soil/Grass

Wetland

SWMU/AOC

AOC Area

SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-33
Drainage Basin 48

November 2002 | Zone J Main Project.apr

Table 4.33.1
Drainage Basin 48 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 660	Mosquito Control Facility	Draft RFI Report
AOC 663	Gas/Diesel Pumping Station, Bldg. 851	Draft RFI Report; RFI Report Addendum Phase II
AOC 665	Pyrotechnic Storage	Draft RFI Report
AOC 679	Former Wash Rack	Draft RFI report; CMS Work Plan; NFA

4.33.1.1 SWMU 13

Site Description and History

SWMU 13, the current firefighter training area for surface and submarine fleet personnel, has operated since 1973. Diesel fuel and gasoline are ignited during training in a contained, paved, and bermed area. Water and fuel drainage is directed into drains and then into oil-water separators, which drain into the sewer system. Recovered petroleum products are recycled. A UST associated with the fire fighting training area is in the northwest portion of SWMU 13.

Previous Investigations

A summary of investigative activities performed at SWMU 13 is presented in Table 4.33.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone H RFI Report*.

Table 4.33.2
Summary of SWMU 13 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil and groundwater	
		Round 1 **Soil:** 23 surface borings (0 to 1 foot) 17 subsurface borings (3 to 5 feet) (013SB001 – 013SB023): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH.	***Round 1*** **Groundwater:** 9 shallow wells (plus 2 nearby existing wells)(013001 – 013009): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH

Table 4.33.2
Summary of SWMU 13 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		(5 duplicates collected for herbicides, Cr6, OP pesticides, and dioxins [3u/3l])	
RFI (EnSafe)	1995	***Round 2*** **Soil:** 5 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (013SB024 – 013SB028): Dioxins (2 duplicates collected for the same parameters)	***Round 2*** **Groundwater:** 9 shallow wells (013001 – 013009): SVOCs, pesticides, metals (1 duplicate collected for the same parameters)

Nature and Extent of Contaminants

Approximately 37 sample locations associated with SWMU 13 were evaluated for the presence of contaminants in 1995. Of these 37, approximately 31 locations are within the boundaries of Drainage Basin 48. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the combined site. Of particular interest were detections of TPH in soil; and beryllium in groundwater.

4.33.1.2 SWMU 136 and AOC 663

Site Description and History

SWMU 136 is the former SAA Number 19, which received hazardous waste from nearby Building NS-53. This area consisted of a wooden framed, wire mesh cage approximately 12 feet long, 4 feet wide, and 6 feet tall. The cage was used to enclose waste accumulation drums placed on wooden pallets. At the time the EBS was completed in December 1993, the SAA housed two empty drums. According to the RFA report, waste materials, including empty paint and motor oil cans, were stored at the SAA. The dates it operated are not known; it was removed from the site before July 1996, when the RFI was completed.

AOC 663 is a former fuel dispenser island that was identified as facility number NS-851. The dispenser island was used to pump fuel from two underground storage tanks UST 851A, a 500-gallon gasoline tank and UST 851B, a 500-gallon diesel fuel tank. The USTs and associated fuel

lines were removed by the Navy in June 1996. Five flammable storage lockers were also noted near NS-851 during the EBS. The lockers were reported to have been used to store fuel for grounds maintenance equipment.

Previous Investigations

A summary of investigative activities performed at AOC 663 and SWMU 136 is presented in Table 4.33.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Zone H RFI Report Addendum.*

Table 4.33.3
Summary of AOC 663 and SWMU 136 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1994	Site investigation of soil and groundwater	
		Round 1 **Soil:** 5 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (663SB001,663SB002, 663SB004, 663SB005, 136SB002): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH (1 duplicate collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins)	***Round 1*** **Groundwater:** 3 shallow wells (663001, 663002, 136001): VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and TPH (1 duplicate collected for same parameters plus herbicides, hexavalent chromium, OP pesticides, and dioxins)
RFI (EnSafe)	1995	***Rounds 2 and 3*** **Soil:** 4 surface borings (0 to 1 foot) 1 subsurface boring (3 to 5 feet) (663SB006-007 and 009, 136SB003-004): SVOCs, metals, pesticides, and PCBs.	***Rounds 2 and 3*** **Groundwater:** 3 shallow wells (663001, 663002, 136001): VOCs, SVOCs, and metals. 2 samples (from AOC 663 wells) also analyzed for herbicides (1 duplicate collected for same parameters)
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 3 shallow wells (663001, 663002, 136001): VOCs, SVOCs, and metals.

Table 4.33.3
Summary of AOC 663 and SWMU 136 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1998	***Round 5*** **Soil:** 8 surface borings (0 to 1 foot) 8 subsurface borings (3 to 5 feet) (136SB005-136SB012): arsenic, beryllium	***Round 5*** **Groundwater:** 3 shallow wells (663001, 663002, 136001): VOCs, and SVOCs
RFI (EnSafe)	1998	***Round 6*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (136SB013-136SB014): arsenic, TOC	***Round 6*** **Groundwater:** No Groundwater Samples Collected.
CH2M-Jones	2001	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 7 shallow well (U02GW004): VOCs, SVOCs (U11GW001-U11GW005, UGW007): alkalinity, sulfate, nitrate, methane, dissolved iron, napthalene

Nature and Extent of Contaminants

Approximately 23 sample locations associated with SWMU 136 and AOC 663 were evaluated for the presence of contaminants between 1994 and 2001. All sample locations are within the boundaries of Drainage Basin 48. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of arsenic in soil and benzene in groundwater.

Supplemental surface soil sampling for arsenic did not identify additional areas in which arsenic exceeded background. Re-evaluation of the surface soil risk attributed to 95% of the upper confidence interval (UCL) arsenic mean concluded that the site risks to a hypothetical resident and general worker (3E-05 and 4E-06) are less than the Zone H background surface soil arsenic risk (4.E-05 and 5E-6, respectively).

The decline in benzene before the closure of the UST system and its absence in groundwater today, suggests the source was local to the area of the well and likely attributed to spillage from the former fuel island. Regardless of benzene's actual origin, removing the UST system has eliminated the potential source of further impacts to groundwater.

The *Zone H RFI Addendum Report* recommended no further action at SWMU 136/AOC 663. Final approval concerning this recommendation is still pending.

4.33.1.3 SWMU 178

Site Description and History

SWMU 178 is the site of a transformer-oil leak from an underground transformer vault approximately 50 feet south of Building X33-A. The leak was identified in 1994. Soil and groundwater were sampled to investigate ant residual contamination from the previous oil leak and other possible spills or leaks.

Previous Investigations

A summary of investigative activities performed at SWMU 178 is presented in Table 4.33.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Zone H RFI Report*.

Table 4.33.4
Summary of SWMU 178 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1994	Site investigation of soil and groundwater	
		Round 1 **Soil:** 6 surfaces borings (0 to 1 foot) 6 subsurface borings (3 to 5 feet) (178SB001 – 178SB006): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH (1 sample split and analyzed for same parameters plus herbicides, hexavalent chromium, OP	***Round 1*** **Groundwater:** 2 shallow wells (178001 and 178002): VOCs, SVOCs, metals, pesticides, PCBs, cyanide, and TPH

Table 4.33.4
Summary of SWMU 178 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		pesticides, and dioxins)	
RFI (EnSafe	1995	***Rounds 2 and 3*** **Soil:** No Soil Samples Collected.	***Rounds 2 and 3*** **Groundwater:** 2 shallow wells (178001 and 178002): SVOCs and metals (2 duplicates collected for same parameters)
RFI (EnSafe	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Rounds 4*** **Groundwater:** 2 shallow wells (178001 and 178002): SVOCs and metals
RFI (EnSafe)	1998	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 2 shallow wells (178001 and 178002): SVOCs and metals
CMS (EnSafe)	1999	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow wells (178001): VOCs and SVOCs

Nature and Extent of Contaminants

Approximately 14 sample locations associated with SWMU 178 were evaluated for the presence of contaminants between 1994 and 1999. All sample locations are within the boundaries of Drainage Basin 48. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in soil.

The *Zone H RFI Report* recommended no further action at SWMU 178 under the RCRA process. The site has been transferred to the Petroleum Storage Tank Program.

4.33.1.4 SWMU 660

Site Description and History

In the 1950s, AOC 660 was used to mix and rinse pesticides associated with mosquito control. This area is currently an asphalt parking lot immediately west of Building NS-53. Soil and

groundwater were sampled at AOC 660 to determine if contamination resulted from pesticide handling or other releases onsite

Previous Investigations

A summary of investigative activities performed at AOC 660 is presented in Table 4.33.5, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone H RFI Report*.

Table 4.33.5
Summary of AOC 660 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1994	Site investigation of soil and groundwater	
		Round 1 **Soil:** 8 surfaces borings (0 to 1 foot) (660SB001 – 660SB008) VOCs, SVOCs, cyanide, metals, pesticides, PCBs 2 subsurface borings (3 to 5 feet) (660SB006 and 660SB007): VOCs, SVOCs, pesticides, PCBs, metals, and cyanide	***Round 1*** **Groundwater:** 2 shallow wells (660001 and 660002): VOCs, SVOCs, metals, pesticides, PCBs, and cyanide
RFI (EnSafe	1995	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 2 shallow wells (660001 and 660002): pesticides and metals
RFI (EnSafe	1995	***Round 3*** **Soil:** No Soil Samples Collected.	***Rounds 3*** **Groundwater:** 2 shallow wells (660001 and 660002): pesticides and metals
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (660001 and 660002): pesticides, PCBs, and metals

Nature and Extent of Contaminants

Approximately 10 sample locations associated with AOC 660 were evaluated for the presence of contaminants between 1994 and 1996. All sample locations are within the boundaries of Drainage Basin 48. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in soil.

The *Zone H RFI Report* recommended no further action at AOC 660.

4.33.1.5 SWMU 665

Site Description and History

AOC 665 stored unknown pyrotechnics from 1943 until the shed was demolished at an unknown date. Currently Buildings 1889 and NS-46 occupy the site where the pyrotechnic shed was formerly located.

Soil was sampled at AOC 665 to determine if residual contamination was associated with the former storage facility.

Previous Investigations

A summary of investigative activities performed at AOC 665 is presented in Table 4.33.6, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Zone H RFI Report*.

Table 4.33.6
Summary of AOC 665 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1994	Site investigation of soil and groundwater	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) (665SB001 – 665SB004)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Table 4.33.6
Summary of AOC 665 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		VOCs, SVOCs, cyanide, metals, pesticides, PCBs, TPH 4 subsurface borings (3 to 5 feet) (665SB001 – 665SB004) VOCs, SVOCs, cyanide, metals, pesticides, PCBs, TPH (1 duplicate sample analyzed for the above standard suite as well as hexavalent chromium, herbicides, OP pesticides, and dioxins)	
RFI (EnSafe	1997	***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) 1 subsurface boring (3 to 5 feet) (665SB005): SVOCs and explosives	***Round 2*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately five sample locations associated with AOC 665 were evaluated for the presence of contaminants between 1994 and 1997. All sample locations are within the boundaries of Drainage Basin 48. Surface and subsurface soil samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs and TPH in soil, specifically surface soil. No groundwater sampling was conducted at this AOC.

The *Zone H RFI Report* recommended including surface soil at AOC 665 in the CMS process on the basis of projected resident risk for BEQs and TPH concentration.

4.33.1.6 SWMU 679

Site Description and History

AOC 679 consists of a former Wash Rack noted on early CNC maps from the 1930s and 1940s. This former wash rack was located off the west edge of Building NS-1. No information is available regarding the design features, years of operation, or operating practices for the wash rack. It is assumed that activities at this unit included washing or cleaning of equipment in an external wash area.

AOC 678, the former site of Building 2-V the Firefighter Training School, northeast of Building NS-1 was combined with AOC 679 during the RFI investigation. The firefighting school was reportedly constructed in 1947 and demolished circa 1955. Controlled fires may have been ignited and extinguished onsite for firefighter training. No other details regarding the design features or operating practices were available. Currently, the area is a paved parking lot.

Previous Investigations

A summary of investigative activities performed at combined AOC 678/679 is presented in Table 4.33.7, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. In addition, grid-based soil and groundwater samples were procured and used for data interpretation. Detailed discussions and results are presented in the *Zone I RFI Report.*

Table 4.33.7
Summary of Combined 678/679 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil and groundwater	
		Round 1 **Soil:** 22 surface borings (0 to 1 foot) (679SB001 – 679SB012) (678SB001 – 678SB003, 678SB005 – 678SB008, and 678SB11 – 678SB14): VOCs, SVOCs, cyanide, metals, pesticides, OP pesticides, organotins, and PCBs 12 subsurface borings (3 to 5 feet) (679SB002 – 679SB012) (678SB001 678SB001 – 678SB003, 678SB005 – 678SB008, and 678SB11 – 678SB14): VOCs, SVOCs, cyanide, metals, pesticides, OP pesticides, organotins, and PCBs (3 duplicate sample analyzed for Appendix IX parameters)	***Round 1*** **Groundwater:** 3 shallow wells (678001 – 678003): VOCs, SVOCs, cyanide, metals, pesticides, OP pesticides, organotins, and PCBs
RFI (EnSafe)	1995	***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) (665SB005): metals	***Round 2*** **Groundwater:** No Groundwater Samples Collected.

Table 4.33.7
Summary of Combined 678/679 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 3 shallow wells (678001 – 678003): cyanide, metals (1 duplicate collected for same parameters)
RFI (EnSafe)	1998	***Round 4*** **Soil:** 1 surface boring (0 to 1 foot) 1 subsurface boring (3 to 5 feet) (665SB015): VOC, SVOC, and metals	***Round 4*** **Groundwater:** 1 shallow well (679001): VOCs, SVOCs, cyanide, metals
RFI (EnSafe)	1999	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (679001): VOCs, SVOCs, metals
RFI (EnSafe)	1999	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 1 shallow well (679001): VOCs, SVOCs, metals
RFI (EnSafe	1999	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 1 shallow well (679001): VOCs

Nature and Extent of Contaminants

Approximately 28 sample locations associated with combined AOC 678/679 were evaluated for the presence of contaminants between 1995 and 1999. All sample locations are within the boundaries of Drainage Basin 48. Surface and subsurface soil and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of isodrin in surface soil.

4.33.1.7 Other Investigated Areas (OIA) G80

Site Description and History

During the construction of deep monitoring well NBCHGDH04D, which is located approximately 70 feet south of the intersection of Hobson Avenue and West Osprey Street, a piece of treated timber (possibly old piling) was removed from the borehole. Analytical results

for the soil sample collected from this borehole reflected significant concentrations of SVOCs. Additional soil samples collected in the vicinity of the borehole did not reflect the degree of contamination identified in the borehole. However, the soil samples were not collected at the same depth as the sample from the borehole. Analysis of groundwater from the shallow well located approximately 10 feet from the borehole that was the source of the contaminated soil sample also did not report the chemicals identified in the soil sample, nor did groundwater analysis from the deep well. Apparently, the analytical results for the soil sample collected while drilling the deep borehole represent a very isolated area of contamination, likely centered around an old treated piling. Furthermore, as evidenced by the shallow groundwater sample results, contamination has apparently not significantly migrated from the piling into the surrounding groundwater.

Previous Investigations

A summary of investigative activities performed at OIA G80 is presented in Table 4.33.8, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Zone H RFI Report*.

Table 4.33.8
Summary of OIA G80 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) (G80SB001 – G80SB004) VOCs and SVOCs 4 subsurface borings (3 to 5 feet) (G80SB001 – G80SB004) VOCs and SVOCs (1 duplicate sample analyzed for the above standard suite as well as hexavalent chromium, herbicides, OP pesticides, and dioxins)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Table 4.33.8
Summary of OIA G80 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	***Round 2*** **Soil:** 3 surface borings (0 to 1 foot) (G80SB005 – G80SB007): SVOCs 3 subsurface borings (3 to 5 feet) (G80SB005 – G80SB007): SVOCs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately seven sample locations associated with OIA 665 were evaluated for the presence of contaminants between 1995 and 1996. All sample locations are within the boundaries of Drainage Basin 48. Surface and subsurface soil samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs, specifically surface soil. No groundwater impact was noted at this OIA.

4.33.1.8 SWMU 177/RTC

Site Description and History

The SWMU 177/RTC was not addressed in the *Final Zone I RFI Work Plan* (E/A&H, February 1995). This site was determined by USEPA Region IV to warrant limited investigation in conjunction with current construction activities. SWMU 177/RTC consisted of two adjacent buildings, both designated as Building RTC-4. The original RTC-4 was a 24 x 60 foot metal structure used to house heavy equipment including backhoes and trackhoes. The designation RTC-4 was given to a newer building constructed next to the former RTC-4. The newer RTC-4 was used to store lawn mowers and other lawn maintenance equipment. This unit was designated as a SWMU due to oil spillage associated with operations at the two buildings. Visual inspections during the RFA identified several areas of stained soil and concrete in and around the two buildings. These buildings were both less than 50 feet from the Cooper River.

This area was included in a lease agreement between the Navy and NOAA in the spring of 1995. Since taking over this area, NOAA has removed both buildings and has installed a diesel fuel AST and three generators at the site.

Previous Investigations

A summary of investigative activities performed at SWMU177/RTC is presented in Table 4.33.9, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Zone I RFI Report*.

Table 4.33.9
Summary of SWMU 177/RTC Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil and groundwater	
		Round 1 **Soil:** 10 surface borings (0 to 1 foot) (RTCSB001 – RTCSB010) VOCs, SVOCs, metals, pesticides, OP pesticides, cyanide, PCBs; (2 duplicates collected for above analyses and dioxins)	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** 7 surface borings (0 to 1 foot) (177SB001 – 177SB007) VOCs, SVOCs, metals, pesticides, OP pesticides, cyanide, PCBs; TPH DRO, TPH GRO, dioxins 6 subsurface borings (3 to 5 feet) (177SB002 – 177SB006) VOCs, SVOCs, metals, pesticides, OP pesticides, cyanide, PCBs; TPH DRO, TPH GRO, dioxins	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1998	***Round 3*** **Soil:** 8 surface borings (0 to 1 foot) (177SB008 – 177SB015) VOCs and SVOCs	***Round 3*** **Groundwater:** 2 shallow wells (177001 and 177002): VOCs, SVOCs, and metals
RFI (EnSafe)	1998	***Round 4*** **Soil:** 4 surface borings (0 to 1 foot) 177SB016 – 177SB019 VOCs and SVOCs	***Round 4*** **Groundwater:** 2 shallow wells (177001 and 177002): VOCs, SVOCs, and metals
RFI (EnSafe)	1999	***Round 5*** **Soil:** No Soil Samples Collected	***Round 5*** **Groundwater:** 2 shallow wells (177001 and 177002): VOCs, SVOCs, and metals

Table 4.33.9
Summary of SWMU 177/RTC Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1999	***Round 6*** **Soil:** No Soil Samples Collected	***Round 6*** **Groundwater:** 2 shallow wells (177001 and 177002): VOCs, SVOCs, and metals

Nature and Extent of Contaminants

Approximately 31 sample locations associated with SWMU 177/RTC were evaluated for the presence of contaminants between 1995 and 1999. All sample locations are within the boundaries of Drainage Basin 48. Surface and subsurface soil samples and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs, specifically in surface soil.

The *Zone H RFI Report* recommended including surface soil and groundwater at SWMU 177/RTC in the CMS process on the basis of projected resident risk for BEQs.

4.33.2 Storm Water Effluent Evaluation

Three storm water effluent samples were collected to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 48 into the Cooper River. Samples were collected at manhole 48/1/1 on June 22, 2002; at catch basin 48/1-A on February 8, 2002; and at catch basin 48/3 on March 2, 2002. Analytical detections for samples EFF046, EFF047, and EFF048 are presented in Table 4.33.10.

Table 4.33.10
Storm Water Effluent Sampling Results
Drainage Basin 48

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L): Reference Concentration	Screening Value (µg/L): Chronic Saltwater Screening Value	Potential COPC
48	48/1/1	EFF046	Aluminum	120	3,277	NL	No

Table 4.33.10
Storm Water Effluent Sampling Results
Drainage Basin 48

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Barium	5.00	60.31	NL	No
			Calcium*	11,000	53,455	NL	No
			Iron	130	4,134	NL	No
			Magnesium*	9,700	49,255	NL	No
			Manganese	4.70	74.52	NL	No
			Potassium*	3,700	23,678	NL	No
			Sodium*	77,000	395,333	NL	No
			Vanadium	2.30	15.59	NL	No
			Zinc	32	307.83	86	No
48	48/1-A	EFF047	Aluminum	36	3,277	NL	No
			Barium	2.60	60.31	NL	No
			Calcium*	2,900	53,455	NL	No
			Copper	7.10	41.98	2.90	No
			Iron	55	4,134	NL	No
			Magnesium*	290	49,255	NL	No
			Manganese	3.20	74.52	NL	No
			Potassium*	360	23,678	NL	No
			Sodium*	2,100	395,333	NL	No
			Vanadium	4.20	15.59	NL	No
			Methoxychlor	**0.17**	**NL**	**NL**	**Yes**
			2-Methylphenol (o-Cresol)	**0.80**	**NL**	**NL**	**Yes**
48	48/3	EFF048	Aluminum	260	3,277	NL	No
			Arsenic	3.40	6.88	36	No
			Barium	9.90	60.31	NL	No
			Calcium*	23,000	53,455	NL	No

Table 4.33.10
Storm Water Effluent Sampling Results
Drainage Basin 48

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Chromium	2.00	13	50	No
			Cobalt	0.96	2	NL	No
			Copper	14	41.98	2.90	No
			Iron	290	4,134	NL	No
			Lead	4.40	33.63	8.50	No
			Magnesium*	18,000	49,255	NL	No
			Manganese	17	74.52	NL	No
			Potassium*	8,200	23,678	NL	No
			Sodium*	140,000	395,333	NL	No
			Vanadium	2.20	15.59	NL	No
			Zinc	58	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.33.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 48. Table 4.33.11 summarizes the migration pathway scenarios.

Table 4.33.11
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 48

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No

Table 4.33.11
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 48

Scenario	Pathway Description	Is Pathway Complete?
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.33.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS, Facility 1308, oil/water separator, had a release of recyclable waste oil that occurred on 2 September 1992. The areas were cleaned up, but it was noted that runoff from the contaminated areas goes directly to the storm drain. In a memo dated 3 October 1991, it was noted that an oil spill at outfall 48 was traced back to the storm water sewer lines around Facility NS-53.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF046, EFF047, and EFF048 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.33.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 67 catch basins is near a surface soil sample location associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zones H and I background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source of methoxychlor, or 2-methylphenol in the storm sewer system.

4.33.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 48 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with methoxychlor, or 2-methylphenol intercepting the storm water drainage pipeline within Drainage Basin 48.

4.33.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 48.

4.33.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 48 due to a lack of an upland terrestrial source identification.

4.34 Drainage Basins 48A to 48G

Drainage Basins 48A to 48G encompass approximately 10.84 acres within Zone I in the south section of the CNC in the vicinity of Berthing Piers S, T and U on the Cooper River. Buildings NS-1 through NS-4, NS-26, 1807 and 2V are in these combined drainage basins. Land cover within the drainage basins consists of approximately 10% unpaved surfaces, 75% paved surfaces and 15% buildings. The combined drainage basin is bordered to the north and northeast by the Cooper River, to the east by light industrial and administrative buildings and paved areas, and to the south and southwest by administrative buildings, bachelor enlisted quarters, and light industrial operations along Hobson Avenue. All storm water runoff within the drainage basins is directed to at least one of the 10 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfalls 48A to 48G.

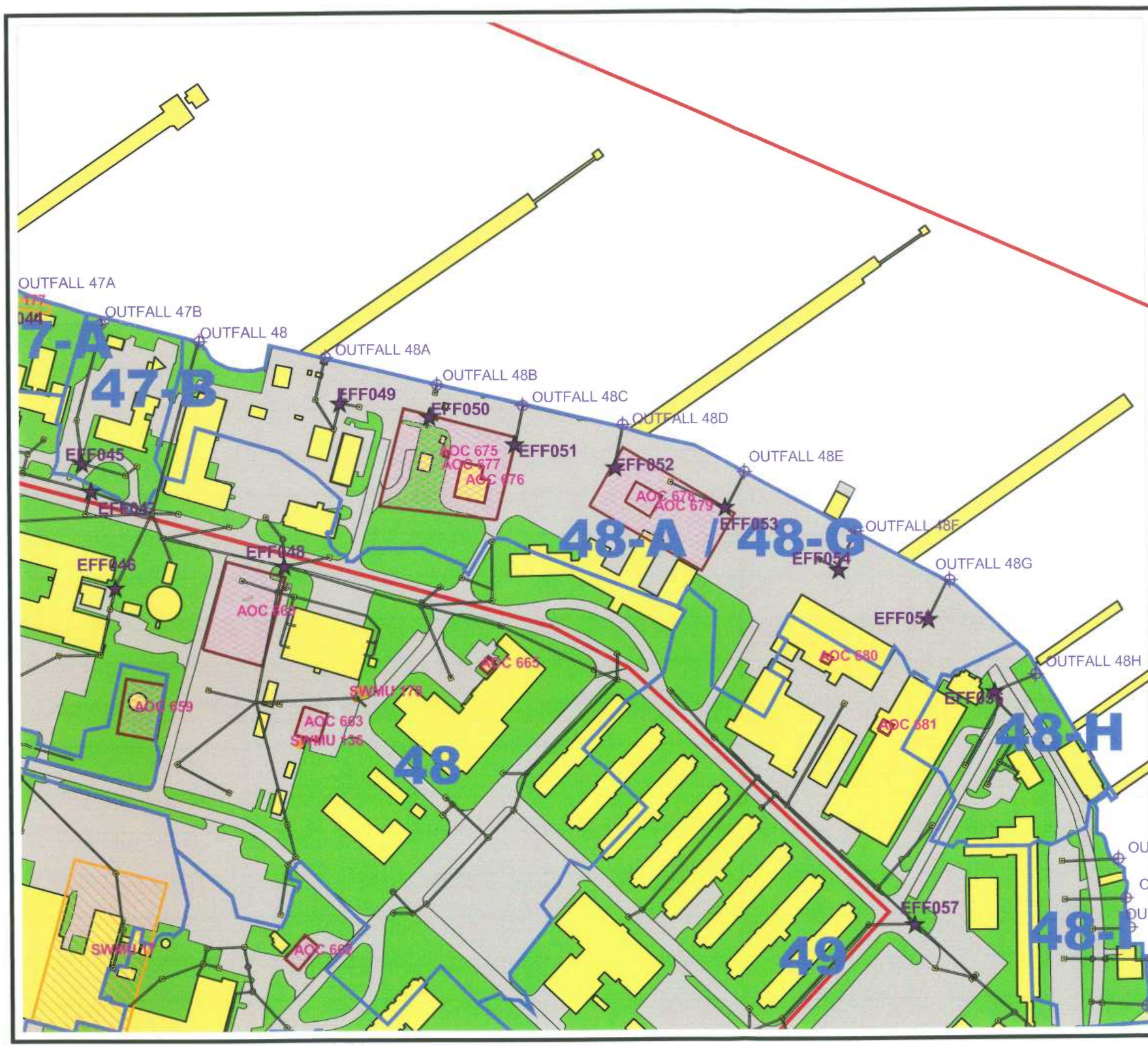
Figure 4-34 illustrates the area encompassing Drainage Basins 48A to 48G and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.34.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates there are six SWMUs/AOCs that are partly or completely within the boundary of Drainage Basins 48A to 48G. Six sites are listed in Table 4.34.1 along with their current status. These potential source areas are AOCs 675/676/677, 678/679 and 680 and include former USTs, a former incinerator, past surface fuel spills, a former firefighter training area and light industrial areas.

Table 4.34.1
Drainage Basins 48A to 48G SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOCs 675/676/677	Building NS-2	Draft RFI Report; CMS Work Plan; NFA
AOCs 678/679	Firefighter School and Wash Rack	Draft RFI Report; CMS Work Plan; NFA
AOC 680	Building NS-26	Draft RFI Report; CMS Work Plan



N

200 0 200 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-34
Drainage Basin 48A/48G

November 2002 | Zone J Main Project.apr

4.34.1.1 AOCs 675/676/677

Site Description and History

AOC 675 is a former 25,000-gallon UST installed in 1952 that stored fuel oil for a boiler house (Building NS-2) built in 1958. The boiler used No. 5 fuel oil until 1991, after which No. 2 fuel oil was consumed. A 495-gallon oil-water separator (NS-2A) is located north of this UST. The lines of the UST have been plugged and capped, thus effectively removing the UST from service. An unregulated 560-gallon waste oil UST associated with oil-water separator NS-2A was removed in April 1996. No holes or pitting were observed during removal of the waste oil UST. The AOC 675 area was also used to refuel seaplanes until the mid-1950s. Former UST NS 3-1 was a 280-gallon waste oil tank and oil-water separator just north of Building NS-3 which is a former fuel pumping transfer station. The fuel transfer area was diked and sloped toward catch basin 48C-A. Valves directed the storm water runoff directly to the storm sewer (and Outfall 48-C) during normal operations. In the event of a spill in the fuel transfer area, flow was routed through the oil-water separator then to the storm sewer.

AOC 676 is the location of a former incinerator used during the 1940s near the current location of Building NS-2.

AOC 677 consists of the grounds surrounding Building NS-2, a boiler house built in 1958. There is documented history of fuel oil spills at this site, ranging from 3 to 500 gallons. Prior to 1979, the sump pump for the boilers discharged to the storm sewer system. After 1979, discharge of the sump was re-directed to the sanitary sewer system via an oil-water separator.

Previous Investigations

A summary of investigative activities performed at AOCs 675/676/677 is presented in Table 4.34.2. Detailed discussions and results are presented in the *Final Zone I RFI.*

Table 4.34.2
Summary of AOCs 675/676/677 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
RFI (EnSafe)	1995	Site investigation of soil and groundwater.

Table 4.34.2
Summary of AOCs 675/676/677 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	***Round 1*** **Soil:** 14 surface borings (0 to 1 foot) 8 subsurface borings (3 to 5 feet) (675SB001-675SB002, 676SB001-676SB002, 677SB001-677SB004, 677SB006-677SB010): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, organotins ***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) (677SB010): Physical parameters (cation exchange capacity [CEC], chloride, sulfur, ammonia, nitrate/nitrite, phosphorous, TOC and total moisture)	***Round 1*** **Groundwater:** 4 shallow wells (675001-675002, 676001, 677002): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, organotins, chloride, sulfate and TDS. (1 duplicate for Appendix IX parameters, VOCs, SVOCs, pesticides, PCBs, metals, cyanide, organotins, chloride, sulfate, TDS ***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 3, 4 and 5*** **Soil:** No Soil Samples Collected.	***Rounds 3, 4 and 5*** **Groundwater:** 4 shallow wells (675001-675002, 676001, 677002): VOCs, SVOCs, cyanide, metals, pesticides and PCBs.

Nature and Extent of Contaminants

Approximately 22 sample locations associated with AOC 675/676/677 were evaluated for the presence of contaminants between 1995 and 1996. All of these 22 locations are within the boundaries of Drainage Basin 48A/48G. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the fuel oil UST, fueling operations, incinerator operations, and fuel oil spills associated with boiler operations. Of particular interest were detections of thallium and dimethoate in groundwater.

4.34.1.2 AOCs 678/679

Site Description and History

AOC 678 is the site of a former 1940s to 1950s Firefighter School (Building 2-V) where controlled fires may have been ignited and extinguished during training. This AOC is currently a paved parking lot.

AOC 679 is a former wash rack noted on CNC figures from the 1930s and 1940s as being located near the west end of Building NS-1. It is assumed that activities at this unit included washing or cleaning of equipment in an external wash area. This AOC is currently also a paved parking lot.

Previous Investigations

A summary of investigative activities performed at AOCs 678/679 is presented in Table 4.34.3. Detailed discussions and results are presented in the *Final Zone I RFI Report* (EnSafe, 1999).

Table 4.34.3
Summary of AOCs 678/679 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil and groundwater	
		Round 1 **Soil:** 21 surface borings (0 to 1 foot) 12 subsurface borings (3 to 5 feet) (678SB001-678SB003, 678SB005-678SB009, 678SB011-678SB012, 679SB002-679SB012): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, cation, chloride, sulfur, ammonia, nitrate/nitrite, phosphorous, TOC and total moisture.	***Round 1*** **Groundwater:** 2 shallow wells (678001, 678002): VOCs, SVOCs, pesticides, PCBs, cyanide, organotins, chloride, TDS, sulfates
RFI (EnSafe)	1995	***Round 2*** **Soil:** 2 surface borings (0 to 1 foot) (678SB013-678SB014): metals	***Round 2*** **Groundwater:** 2 shallow wells (678001, 678002): cyanide and metals
RFI (EnSafe)	1995	***Round 3*** **Soil:** 1 surface boring (0 to 1 foot) 1 subsurface boring (3 to 5 feet)	***Round 3*** **Groundwater:** 2 shallow wells (678001, 678002): cyanide and metals

Table 4.34.3
Summary of AOCs 678/679 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		(679SB015): VOCs, SVOCs and metals	
RFI (EnSafe)	1999	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (678001, 678002): chloride, cyanide, sulfate, metals, pesticides, VOCs and TDS
RFI (EnSafe)	1999	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 1 shallow well (679001): VOCs

Nature and Extent of Contaminants

Approximately 39 sample locations associated with AOC 678/679 were evaluated for the presence of contaminants between 1995 and 1999. All of these 39 locations are within the boundaries of Drainage Basin 48A/48G. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to equipment washing or fuel burning activities at the site. Of particular interest were detections of Isodrin in surface soil.

4.34.1.3 AOC 680
Site Description and History

AOC 680 includes Building NS-26 (constructed 1958) and its associated former grinding room/brake repair area, and a 200-gallon waste oil UST. The UST and three sampling locations were located near Outfalls 48F and 48G. According to the Environmental Baseline Survey for Lease (EBSL) and the Naval Energy and Environmental Support Activity (NEESA) reports, from 1958 through 1991 disposal practices reportedly included discharging neutralized boiler solutions, solvents, and mercuric nitrate solutions directly into the Cooper River. When the UST was closed by removal in December 1996, it was noted that the tank and associated piping were severely corroded and pitted, but no holes were identified.

Previous Investigations

A summary of investigative activities performed at AOC 680 is presented in Table 4.34.4. Detailed discussions and results are presented in the *Final Zone I RFI* (EnSafe, 1999).

Table 4.34.4
Summary of AOC 680 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1998	Site soil and groundwater investigation	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) (680SB001 to 680SB004) 3 subsurface borings (3 to 5 feet) (680SB001 to 680SB004): VOCs, SVOCs, and metals (1duplicate surface soil sample collected for the same parameters)	***Round 1*** **Groundwater:** 3 shallow wells (680001 to 680003): VOCs and SVOCs
RFI (EnSafe)	1998	***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) 1 subsurface borings (3 to 5 feet) (680SB005), SVOCs, metals, pesticides, PCBs, and cyanide	***Round 2*** **Groundwater:** 3 shallow wells (680001 to 680003): VOCs, SVOCs, and metals
RFI (EnSafe)	1998	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 1 shallow well (680004): VOCs

Nature and Extent of Contaminants

Approximately nine sample locations associated with AOC 680 were evaluated for the presence of contaminants in 1998. Of these nine, five locations are within the boundaries of Drainage Basin 48A/48G. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to brake repair, welding, grinding, or UST activities at the site. Of particular interest were detections of BEQs in surface soil and detections of arsenic and tetrachloroethene in shallow groundwater.

4.34.2 Storm Water Effluent Evaluation

Storm water effluent samples were collected at catch basins 48A-A1, 48B-A1, 48C-A, 48D-A, 48E-A, 48F-A, and 48G-A on June 27, 2001, to determine if constituents are migrating from the AOCs associated with Drainage Basins 48A through 48G into the Cooper River. Analytical detections for samples EFF049, EFF050, EFF051, EFF052, EFF053, EFF054, and EFF055 are presented in Table 4.34.5.

Table 4.34.5
Storm Water Effluent Sampling Results
Drainage Basins 48A to 48G

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
48A/48G	48A-A1	EFF049	Aluminum	210	3,277	NL	No
			Barium	19	60.31	NL	No
			Cadmium	1.00	1.29	9.30	No
			Calcium*	7,800	53,455	NL	No
			Chromium	4.50	13	50	No
			Copper	**100**	**41.98**	**2.90**	**Yes**
			Iron	220	4,134	NL	No
			Lead	5.10	33.63	8.50	No
			Magnesium*	550	49,255	NL	No
			Manganese	16	74.52	NL	No
			Nickel	1.90	5.14	8.30	No
			Potassium*	1,400	23,678	NL	No
			Sodium*	3,500	395,333	NL	No
			Vanadium	4.30	15.59	NL	No
			Zinc	190	307.83	86	No
			Mercury	**0.17**	**NL**	**0.025**	**Yes**
			Alpha-BHC	0.018	NL	1400	No
			Heptachlor	**0.0086**	**NL**	**0.0036**	**Yes**
			bis(2-Ethylhexyl) phthalate	**0.52**	**NL**	**NL**	**Yes**
	48B-A1	EFF050	Aluminum	1,500	3,277	NL	No
			Barium	38	60.31	NL	No
			Calcium*	140,000	53,455	NL	No
			Chromium	9.30	13	50	No
			Cobalt	1.00	2.00	NL	No
			Copper	**140**	**41.98**	**2.90**	**Yes**

Table 4.34.5
Storm Water Effluent Sampling Results
Drainage Basins 48A to 48G

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Iron	2,000	4,134	NL	No
			Lead	4.60	33.63	8.50	No
			Magnesium*	2,700	49,255	NL	No
			Manganese	50	74.52	NL	No
			Nickel	**8.30**	**5.14**	**8.30**	**Yes**
			Potassium*	2,700	23,678	NL	No
			Sodium*	3,700	395,333	NL	No
			Vanadium	11	15.59	NL	No
			Zinc	80	307.83	86	No
	48B-A1	EFF051	**Aluminum**	**6,400**	**3,277**	**NL**	**Yes**
			Barium	49	60.31	NL	No
			Beryllium	0.14	0.41	NL	No
			Calcium*	45,000	53,455	NL	No
			Chromium	26	13	50	No
			Cobalt	1.80	2.00	NL	No
			Copper	**370**	**41.98**	**2.90**	**Yes**
			Iron	**4,300**	**4,134**	**NL**	**Yes**
			Lead	**35**	**33.63**	**8.50**	**Yes**
			Magnesium*	2,100	49,255	NL	No
			Manganese	60	74.52	NL	No
			Nickel	**9.30**	**5.14**	**8.30**	**Yes**
			Potassium*	1,700	23,678	NL	No
			Silver	0.53	2.34	0.23	No
			Sodium*	2,700	395,333	NL	No
			Tin	**5.00**	**NL**	**NL**	**Yes**
			Vanadium	**43**	**15.59**	**NL**	**Yes**
			Zinc	170	307.83	86	No
	48D-A	EFF052	**Aluminum**	**4,700**	**3,277**	**NL**	**Yes**
			Barium	20	60.31	NL	No
			Beryllium	0.18	0.41	NL	No
			Calcium*	16,000	53,455	NL	No
			Chromium	11	13	50	No
			Cobalt	0.72	2.00	NL	No
			Copper	29	41.98	2.9	No
			Iron	2,300	4,134	NL	No
			Lead	8.00	33.63	8.50	No

Table 4.34.5
Storm Water Effluent Sampling Results
Drainage Basins 48A to 48G

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Magnesium*	1,000	49,255	NL	No
			Manganese	54	74.52	NL	No
			Nickel	4.60	5.14	8.3	No
			Potassium*	2,500	23,678	NL	No
			Sodium*	2,700	395,333	NL	No
			Vanadium	**41**	**15.59**	**NL**	**Yes**
			Zinc	53	307.83	86	No
			4,4'-DDD	**0.033**	**NL**	**0.025**	**Yes**
			4,4'-DDT	**0.034**	**NL**	**0.001**	**Yes**
			Endosulfan II	**0.018**	**NL**	**0.0087**	**Yes**
			Heptachlor	**0.038**	**NL**	**0.0036**	**Yes**
	48E-A	EFF053	**Aluminum**	**13,000**	**3,277**	**NL**	**Yes**
			Barium	53	60.31	NL	No
			Beryllium	0.36	0.41	NL	No
			Calcium*	36,000	53,455	NL	No
			Chromium	26	13	50	No
			Cobalt	**3.00**	**2.00**	**NL**	**Yes**
			Copper	22	41.98	2.90	No
			Iron	**6,500**	**4,134**	**NL**	**Yes**
			Lead	17	33.63	8.50	No
			Magnesium*	2,100	49,255	NL	No
			Manganese	**98**	**74.52**	**NL**	**Yes**
			Nickel	**10**	**5.14**	**8.30**	**Yes**
			Potassium*	2,700	23,678	NL	No
			Sodium*	3,300	395,333	NL	No
			Vanadium	**48**	**15.59**	**NL**	**Yes**
			Zinc	62	307.83	86	No
			Endosulfan I	**0.022**	**NL**	**0.0087**	**Yes**
			Heptachlor	**0.013**	**NL**	**0.0036**	**Yes**
	48F-A	EFF054	Aluminum	660	3,277	NL	No
			Barium	17	60.31	NL	No
			Cadmium	0.80	1.29	9.30	No
			Calcium*	11,000	53,455	NL	No
			Chromium	7.90	13	50	No
			Copper	**62**	**41.98**	**2.90**	**Yes**
			Iron	1,000	4,134	NL	No

Table 4.34.5
Storm Water Effluent Sampling Results
Drainage Basins 48A to 48G

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Lead	14	33.63	8.50	No
			Magnesium*	640	49,255	NL	No
			Manganese	20	74.52	NL	No
			Nickel	6.20	5.14	8.30	No
			Potassium*	1,100	23,678	NL	No
			Silver	1.40	2.34	0.23	No
			Sodium*	3,200	395,333	NL	No
			Vanadium	6.70	15.59	NL	No
			Zinc	160	307.83	86	No
	48G-A	EFF055	Aluminum	1,100	3,277	NL	No
			Barium	30	60.31	NL	No
			Cadmium	1.50	1.29	9.30	No
			Calcium*	12,000	53,455	NL	No
			Chromium	22	13	50	No
			Cobalt	0.88	2.00	NL	No
			Copper	**170**	**41.98**	**2.90**	**Yes**
			Iron	2,600	4,134	NL	No
			Lead	**49**	**33.63**	**8.50**	**Yes**
			Magnesium*	1,400	49,255	NL	No
			Manganese	52	74.52	NL	No
			Nickel	7.90	5.14	8.30	No
			Potassium*	1,800	23,678	NL	No
			Sodium*	7,000	395,333	NL	No
			Vanadium	15	15.59	NL	No
			Zinc	**310**	**307.83**	**86**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.34.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the Storm water Effluent Report and to determine the applicability of each scenario to Drainage Basins 48A to 48G. The Zone J data evaluation resulted in three possible outcomes based on the available data present for Drainage Basins 48A to 48G. Table 4.34.6 summarizes the migration pathway scenarios.

Table 4.34.6
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basins 48A to 48G

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system →Zone J	No

4.34.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS there have been several reported releases to the storm water sewer system. The boiler waste water at Facility NS-2, former boiler substation, was typically discharged to the storm water drainage system. Chemicals in the waste were caustic soda, sodium sulfite, disodium phosphate, and cyclohexylamine.

Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF049, EFF050, EFF051, EFF052, EFF053, EFF054, and EFF055 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.34.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that 8 of 10 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone I background concentrations and the ecological risk based screening criteria identified

sample location areas consistent with EFF049, EFF050, EFF051, EFF052, EFF053, EFF054, and EFF055 COPCs for entry into the storm sewer system. A summary of this evaluation is provided in Table 4.34.7.

Table 4.34.7
Drainage Basin 48A/48G
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPCs	Concentration (mg/kg)	Screening Value (mg/kg)	Distance to Catch Basin ft.
48D-A	678SB001*	4,4'-DDD	0.022	0.0033 (SSV)	82
		4,4'-DDT	0.0043	0.0033 (SSV)	
	678SB003*	4,4'-DDD	0.025	0.0033 (SSV)	100
	678SB006*	4,4'-DDT	0.007	0.0033 (SSV)	98
	678SB007*	4,4'-DDD	0.17	0.0033 (SSV)	72
		4,4'-DDT	0.042	0.0033 (SSV)	
	678SB008*	4,4'-DDD	0.12	0.0033 (SSV)	57
		4,4'-DDT	0.086	0.0033 (SSV)	
	678SB012*	4,4'-DDD	0.12	0.0033 (SSV)	49
		4,4'-DDT	0.086	0.0033 (SSV)	
	679SB002*	4,4'-DDD	0.017	0.0033 (SSV)	151
	679SB008*	4,4'-DDD	0.0095	0.0033 (SSV)	205

Notes:
* = Sample location is located under pavement and constituents from these locations most likely do not represent complete exposure pathways to the storm water system.

Evaluation of surface soil data to determine possible upland terrestrial source identification with COPCs identified in Table 4.34.5 revealed that 4,4'-DDD and 4,4'-DDT were the only compounds detected in soil above screening criteria at locations between 49 and 205 feet from catch basins. It should be noted that the samples were collected in an area completely covered with pavement; therefore, contaminants in surface soils at this location could not reach the catch basin via sheet flow. Further evaluation is not necessary.

4.34.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative

approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basins 48A to 48G were reviewed. The preliminary evaluation did not identify any groundwater contaminated with COPCs identified in Table 4.34.5 intercepting the storm water drainage pipeline within Drainage Basins 48A to 48G.

4.34.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basins 48A to 48G.

4.34.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basins 48A to 48G due to lack of an upland terrestrial source identification.

4.35 Drainage Basin 48H

Drainage Basin 48H encompasses approximately 2.49 acres within Zone I, located on the eastern section of the CNC. Land cover within the drainage basin consists of approximately 30% unpaved surfaces (i.e., mostly grass), 30% covered by building foundations, and 40% paved surfaces. Storm water runoff within the basin is directed to six catch basins discharging to the Cooper River via Outfall 48H.

Figure 4-35 illustrates the area encompassing Drainage Basin 48H and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.35.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there is one AOC that is partly or completely within the boundary of Drainage Basin 48H. The site is listed in Table 4.35.1, along with its current status. The potential source area is AOC 681 (Blast Booth Building 681). For this basin assessment, note that the southwestern boundary of AOC 681 transcends the northeastern boundary of Drainage Basin 49.

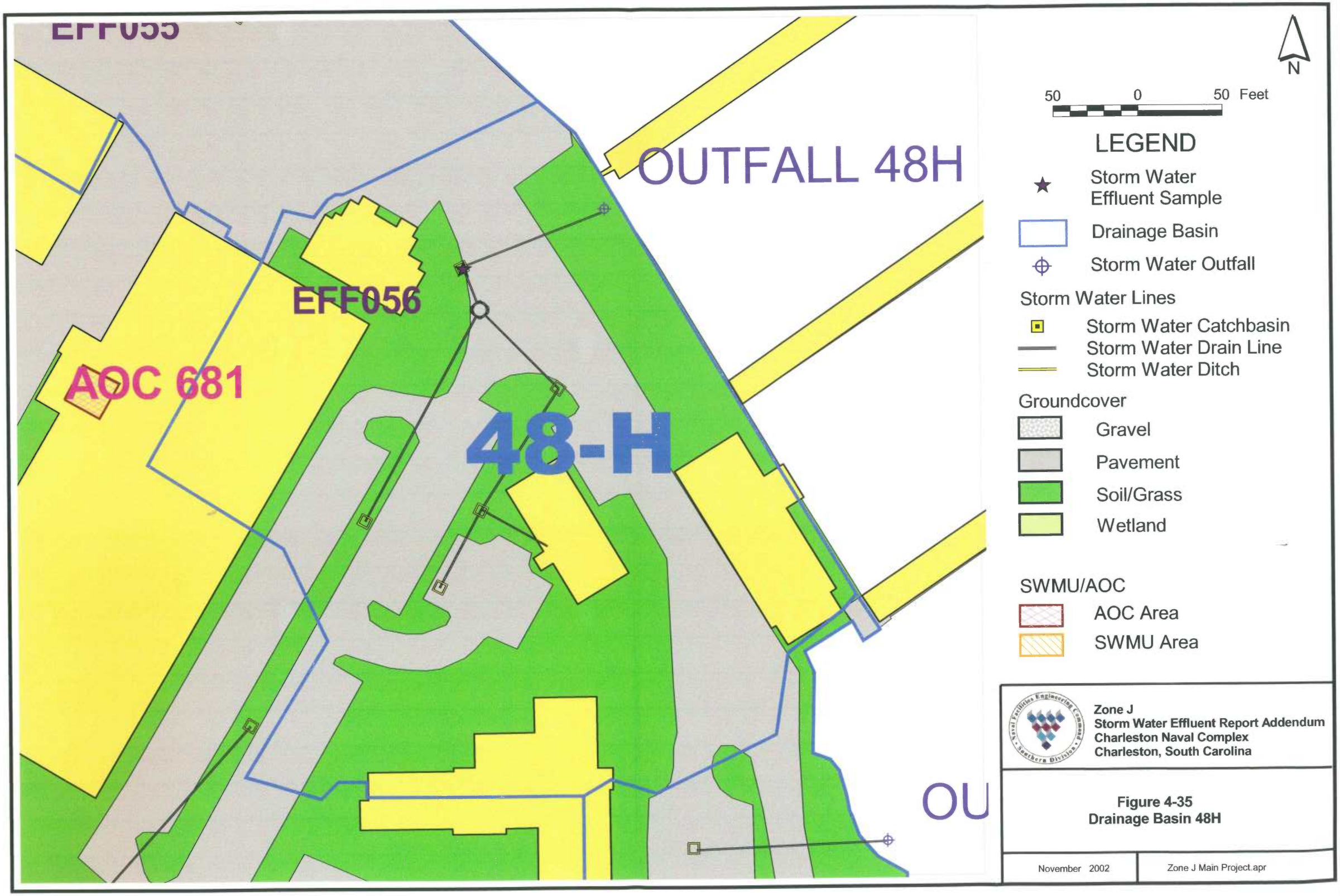
Table 4.35.1
Drainage Basin 48H SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 681	Blast Booth Building 681	RFI Report; RFI Report Addendum; CMS Work Plan; NFA

4.35.1.1 AOC 681
Site Description and History

AOC 681 is the abrasive blast booth on the west side of Building 681 was used for stripping miscellaneous ship and boiler components. The blasting agent (aluminum oxide) was recycled through a cyclone separator and the generated wastes, primarily paint dust, was directed into an outdoor hopper and then into 55-gallon drums for disposal.

Building 681 was constructed in 1985 to serve as a shop and administration building for Shore Intermediate Maintenance Activity (SIMA). The facility contained a hose shop; a canvas


EFF055
OUTFALL 48H
EFF056
AOC 681
48-H
OU
N
50 0 50 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-35
Drainage Basin 48H
November 2002
Zone J Main Project.apr

shop; a tool storage area; a valve shop; a lagging shop; an air conditioning and recovery shop; a hydraulics shop; a paint booth; a blasting booth; a pump shop; a machine shop; an electrical shop; and a varnish dip tank. The facility is currently used as a vessel support facility for the U.S. Coast Guard.

Two underground storage tanks (681-1 and 681-2) were associated with this facility. The tanks were installed in 1985, when the facility was constructed. Both tanks were closed by removal in early 1997.

UST 681-1 was an unregulated 100 gallon waste oil tank located on the southeast side of Building 681. UST 681-2 was an unregulated 20,000 gallon fuel oil tank located on the south side of Building 681. It stored fuel oil for boilers located in Buildings 681 and 680.

Building 680, which is located on the west side of Building 681, was constructed in 1975 and was used for maintenance activities similar to those conducted in Building 681. Engine parts and other equipment were cleaned in dip tanks and/or were sandblasted clean as part of repair and maintenance programs.

An oil/water separator is reportedly located between Buildings 680 and 681 and services both buildings.

In addition, a sanitary and industrial sewer system site plan map from 1968 indicates that an oil/water separator and associated UST was located just at the northeast corner of what is now Building 681.

Previous Investigations

A summary of investigative activities performed at AOC 681 is presented in Table 4.35.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone I RFI Report*.

Table 4.35.2
Summary of AOC 681 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site soil and groundwater investigation.	
		Round 1 **Soil:** 5 surface borings (0 to 1 foot) (681SB001 – 681SB005) VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and organotins (1 duplicate collected for the above methods and Appendix IX parameters) 2 subsurface borings (3 to 5 feet) (681SB001 – 681SB002): VOCs, SVOCs, pesticides, organotins, PCBs, metals, and cyanide	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
Geoprobe Investigation (EnSafe)	1998	***Round 2*** **Soil:** 6 surface borings (0 to 1 foot) (681SB006 – 681SB0011): VOCs, SVOCs, pesticides, PCBs, TPH-DRO (1 duplicate collected for Appendix IX parameters)	***Round 2*** **Groundwater:** 3 shallow wells (681001, 681002, 681003): VOCs, SVOCs, metals, and cyanide
EnSafe	1998	***Round 3*** **Soil**: A geoprobe investigation was conducted after VOCs and SVOCs were detected in groundwater samples in the area surrounding GDI013, which is adjacent to AOC 681	***Round 3*** **Groundwater:** Geoprobe samples collected analyzed for VOCs and SVOCs 3 shallow wells (681001, 681002, 681003): VOCs, SVOCs, pesticides, PCBs, metals, and cyanide
EnSafe	1999	***Round 4*** **Soil**: No Soil Samples Collected.	***Round 4*** **Groundwater:** (681001, 681002, 681003): VOCs, SVOCs, metals, cyanide
CH2M-Jones	2001	***Round 1*** **Soil:** 1 surface boring (0 to 1 foot) (681SB012): SVOCs 7 subsurface borings (3 to 5 feet) (681SB012, 681SB013, 715SB001-715SB003, 718SB001, 781SB002): VOCs, SVOCs, pesticides, PCBs, metals, cyanide	***Round 1*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 18 sample locations associated with AOC 681 were evaluated for the presence of contaminants between 1995 and 2001. Of these 18, approximately 5 are within the boundaries of Drainage Basin 48H. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in subsurface soil and the detection of bis(2-ethylhexyl)phthalate (BEHP) in shallow groundwater.

4.35.2 Storm Water Effluent Evaluation

A storm water effluent sample was collected at catch basin 48H-A on May 18, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 48H into the Cooper River. Analytical detections for sample EFF056 are presented in Table 4.35.3.

Table 4.35.3
Storm Water Effluent Sampling Results
Drainage Basin 48H

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
48H	48H-A	EFF056	Aluminum	94	3,277	NL	No
			Arsenic	12	6.88	36	No
			Barium	9.10	60.31	NL	No
			Calcium*	6,600	53,455	NL	No
			Chromium	6.10	13	50	No
			Copper	**50**	**41.98**	**2.90**	**Yes**
			Iron	150	4,134	NL	No
			Lead	6.00	33.63	8.50	No
			Magnesium*	680	49,255	NL	No
			Manganese	14	74.52	NL	No
			Nickel	2.70	5.14	8.30	No
			Potassium*	980	23,678	NL	No

Table 4.35.3
Storm Water Effluent Sampling Results
Drainage Basin 48H

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Sodium*	3,900	395,333	NL	No
			Vanadium	7.50	15.59	NL	No
			Zinc	180	307.83	86	No
			Bis (2-Ethylhexyl) phthalate	**3.10**	**NL**	**NL**	**Yes**
			Dimethylphthalate	7.90	NL	580	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.35.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 48H. Table 4.35.4 summarizes the migration pathway scenarios.

Table 4.35.4
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 48H

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	No
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system →Zone J	No

4.35.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. No releases impacting the

storm water sewer system within the boundaries of Drainage Basin 48H were discovered during review of environmental incident reports that were maintained by the former CNSY Environmental Office Code 106 between the time period from 1982 until base closure in 1996, and EBS reports prepared for property transfer. Therefore, this pathway is considered incomplete.

4.35.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of six catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone I background concentrations and the ecological risk based screening criteria do not identified any existing locations which have the potential to provide an upland source of bis(2-Ethylhexyl)phthalate and copper in the storm sewer system.

4.35.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 48H were reviewed. The preliminary evaluation did not identify any groundwater contaminated with bis(2-Ethylhexyl)phthalate and copper intercepting the storm water drainage pipeline within Drainage Basin 48H.

4.35.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basins 48H.

4.35.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basins 48H due to a lack of an upland terrestrial source identification.

4.36 Drainage Basin 49

Drainage Basin 49 encompasses approximately 20.6 acres within Zones H and I in the eastern section of the CNC along the Cooper River. Land cover within the drainage basin consists of approximately 30% unpaved surfaces (i.e., mostly grass), 50% paved surfaces, and 20% building foundations. Most storm water runoff within the drainage basin is directed to a storm sewer pipeline with 39 catch basins that discharge to the Cooper River via Outfall 49.

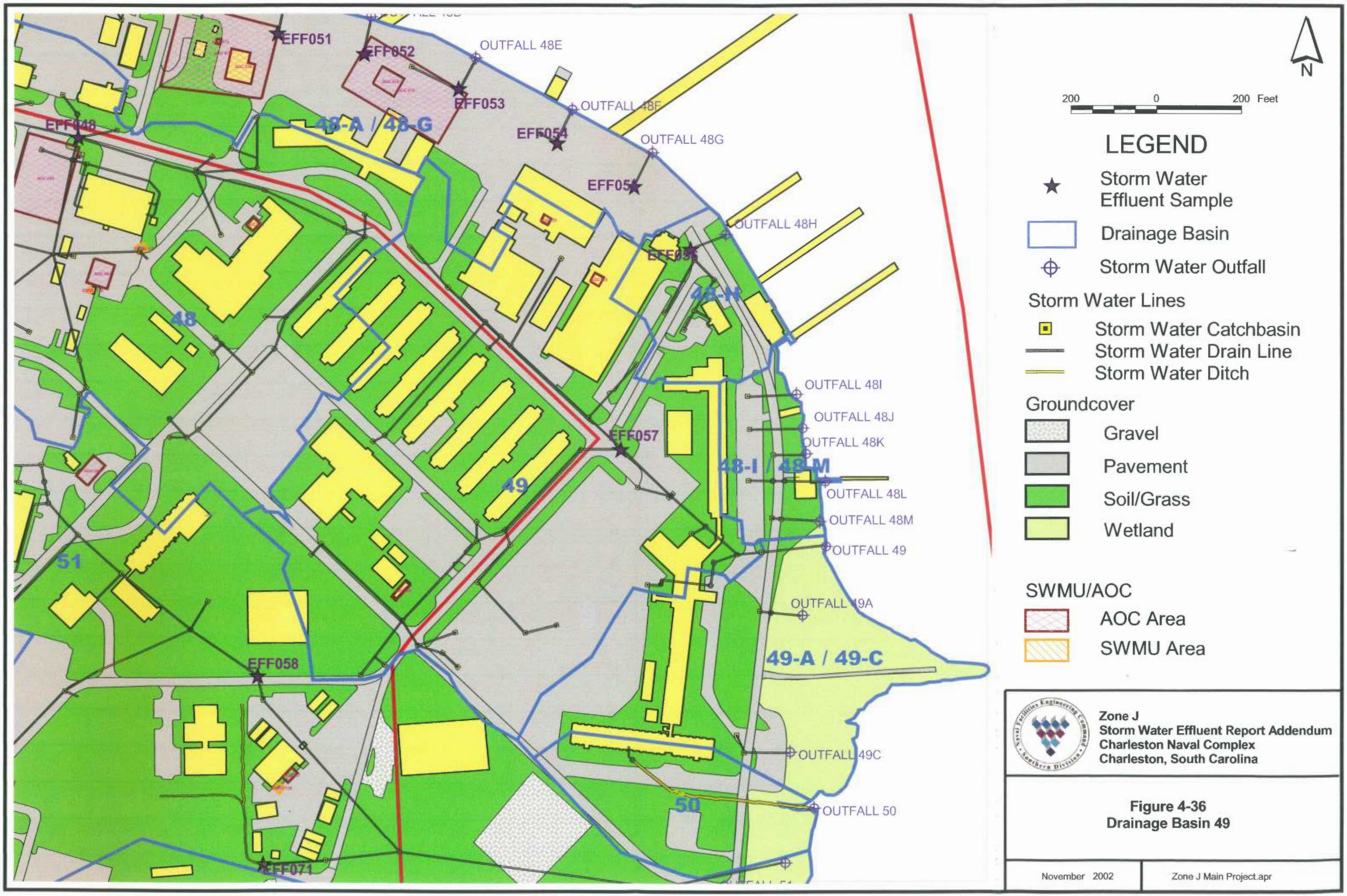
Figure 4-36 illustrates the area encompassing Drainage Basin 49 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.36.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there are three SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 49. The sites are listed in Table 4.36.1 along with their current status. These potential source areas include AOC 666 (Fuel Storage Area), AOC 680 (Brake Repair and Welding Area), AOC 681 (Blast Booth Building 681), and OIA G80. For this basin assessment, note that the northwestern boundary of AOC 680 transcends the southeastern boundaries of Drainage Basins 48 and 48-G and the northeastern boundary of AOC 681 transcends the southwestern boundary of Drainage Basin 48 H. However, the majority of AOC 666, 680, and 681 are located within the boundaries of Drainage Basin 49.

Table 4.36.1
Drainage Basin 49 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 666	Fuel Storage Area, Building NS-45 Area	Draft RFI Report; RFI Report Addendum Phase II, NFA
AOC 680	Brake Repair and Welding Area, Building NS-26 Area	Draft RFI Report; CMS Work Plan
AOC 681	Blast Booth Building 681	Draft RFI Report; CMS Work Plan


EFF051
EFF052
OUTFALL 48E
EFF053
OUTFALL 48F
EFF048
48-A / 48-G
EFF054
OUTFALL 48G
EFF055
OUTFALL 48H
EFF056
48-H
48
OUTFALL 48I
OUTFALL 48J
OUTFALL 48K
EFF057
48-I / 48-M
49
OUTFALL 48L
OUTFALL 48M
OUTFALL 49
51
OUTFALL 49A
49-A / 49-C
EFF058
OUTFALL 49C
50
OUTFALL 50
EFF071
N
200 0 200 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-36
Drainage Basin 49
November 2002
Zone J Main Project.apr

4.36.1.1 AOC 666

Site Description and History

AOC 666 is the area where two former USTs were located adjacent to a boiler house (NS-44) that supplied steam to ships and parts of CNC prior to base closure. NS 44 supplied steam to the Border Patrol cafeteria. The 550-gallon UST NS44A was gravity fed waste oil collection tank for an oil-water separator. The 25,000-gallon UST NS45 supplied No. 2 fuel oil for Building NS 44. Both USTs and associated fuel lines were removed by the Navy DET in August and October 1996. Before the site was constructed in 1958, the surrounding area was an airstrip. Today, most of the area is covered with grass.

Previous Investigations

A summary of investigative activities performed at AOC 666 is presented in Table 4.36.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone H RFI Report*.

Table 4.36.2
Summary of AOC 666 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1994	Site soil and groundwater investigation.	
		Round 1 **Soil:** 7 surface borings (0 to 1 foot) 6 subsurface borings (3 to 5 feet) (666SB001 – 666SB007): VOCs, SVOCs, pesticides, PCBs, TPH, herbicides, OP pesticides, dioxin. (1 duplicate collected for same parameters)	***Round 1*** **Groundwater:** 2 shallow wells (666001 - 666002): VOCs, SVOCs, pesticides, PCBs, TPH, metals (1 duplicate collected for same parameters)
RFI (EnSafe)	1995	***RFI Sampling*** During the initial RFI investigation arsenic was detected in several surface soil samples. The objective of the supplemental soil sampling was to further evaluate the extent of arsenic in surface soil exceeding background.	

Table 4.36.2
Summary of AOC 666 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	***Round 2*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (666SB02A, & 666SB07A): ammonia, cation, chloride, moisture, nitrate, TOC	***Round 2*** **Groundwater:** 2 shallow wells (666001 -666002): VOCs, SVOCs, metals (1 duplicate collected for same parameters)
RFI (EnSafe)	1995	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (666001 -666002): VOCs, SVOCs, metals (1 duplicate collected for same parameters)
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (666001 - 666002): VOCs, SVOCs, metals (1 duplicate collected for same parameters)
RFI Addendum	1998	***Round 5*** **Soil:** 7 surface borings (0 to 1 foot) 6 subsurface borings (3 to 5 feet) (666SB008 – 666SB014): arsenic, beryllium (1 duplicate collected for same parameters)	***Round 5*** **Groundwater:** 2 shallow wells (666001 -666002): VOCs (1 duplicate collected for same parameters)
CH2M-Jones	2001	***Round 1*** **Soil:** No Soil Samples Collected.	***Round 1*** **Groundwater:** 1 shallow well (666003): VOCs
CH2M-Jones	2002	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 1 shallow well (666003): SVOCs, VOCs

Nature and Extent of Contaminants

Approximately 18 sample locations associated with AOC 666 were evaluated for the presence of contaminants between 1994 and 2002. All locations were within the boundaries of Drainage Basin 49. Surface, subsurface, and groundwater samples were collected and analyzed for various

constituents in order to delineate the nature and extent of potential contamination attributable to two former underground storage tanks at the site. Of particular interest were detections of arsenic, vanadium, Aroclor-1260, N-nitroso-di-n-propylamine, and BEQs in surface soil.

4.36.1.2 AOC 680

Site Description and History

AOC 680 includes Building NS-26 and associated former grinding room/welding room/brake repair area. Building NS-26 was part of the Navy's SIMA complex. The building was constructed in 1958 and renovated in 1985. Structures associated with NS-26 include several storage sheds and steel storage trailers.

AOC 680 also included three dip tanks, which were located in the west end of the facility and which were used to clean ship parts. The contents of the tanks were tri-sodium phosphate, citric acid, and water. The tanks reportedly were cleaned bi-annually by CNC personnel.

An initial assessment study in 1981 noted that the following hazardous wastes were generated at this facility: boiler cleaning solution (sulfuric acid and nitric acid); cleaning solvents (chlorinated hydrocarbons); and boiler test chemicals (mercuric nitrate). From 1958 through 1981, disposal practices reportedly included discharging neutralized boiler solutions, solvents, and mercuric nitrate solutions directly into the Cooper River.

Historic information indicates that the area was used as a seaplane refueling ramp and as an oil storage area in the 1940s.

In December 1996, a 200-gallon waste oil UST located on the north side of NS-26 was closed by removal. The UST assessment report noted that the tank and associated piping was severely corroded and pitted but no holes were found. AOC 680 initially included the former grinding room in Building NS-26, which was reportedly used to repair brake components containing asbestos. Building plans from 1969 show the grinding room on the southern side of Building NS-26. Reportedly, brake repair ceased in 1970. The area once occupied by the grinding room was remodeled in 1985 and is now a short hallway to the southern entrance to the building.

Previous Investigations

A summary of investigative activities performed at AOC 680 is presented in Table 4.36.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Zone I RFI Report Addendum* (EnSafe, 1999).

Table 4.36.3
Summary of AOC 680 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1998	Site soil and groundwater investigation	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) (680SB001 to 680SB004) 3 subsurface borings (3 to 5 feet) (680SB001 to 680SB004): VOCs, SVOCs, and metals (1duplicate collected for the same parameters)	***Round 1*** **Groundwater:** 3 shallow wells (680001 to 680003): VOCs and SVOCs
RFI (EnSafe)	1998	***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) 1 subsurface borings (3 to 5 feet) (680SB005): SVOCs, metals, pesticides, PCBs, and cyanide	***Round 2*** **Groundwater:** 3 shallow wells (680001 to 680003): VOCs, SVOCs, and metals
RFI (EnSafe)	1998	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 1 shallow well (680004): VOCs

Nature and Extent of Contaminants

Approximately nine sample locations associated with AOC 680 were evaluated for the presence of contaminants in 1998. Of these nine, two locations are within the boundaries of Drainage Basin 49. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to brake repair, welding, grinding, or UST activities at the site. Of particular interest were

detections of BEQs in surface soil and detections of arsenic and tetrachloroethene in shallow groundwater.

4.36.1.3 AOC 681

Site Description and History

AOC 681 is the abrasive blast booth on the west side of Building 681 used for stripping miscellaneous ship and boiler components. The blasting agent (aluminum oxide) is recycled through a cyclone separator and the generated wastes, primarily paint dust, are directed into an outdoor hopper and then into 55-gallon drums for disposal.

Building 681 was constructed in 1985 to serve as a shop and administration building for SIMA. The facility contained a hose shop; a canvas shop; a tool storage area; a valve shop; a lagging shop; an air conditioning and recovery shop; a hydraulics shop; a paint booth; a blasting booth; a pump shop; a machine shop; an electrical shop; and a varnish dip tank. The facility is currently used as a vessel support facility for the U.S. Coast Guard.

Two underground storage tanks (681-1 and 681-2) were associated with this facility. The tanks were installed in 1985, when the facility was constructed. Both tanks were closed by removal in early 1997.

UST 681-1 was an unregulated 100 gallon waste oil tank located on the southeast side of Building 681.

UST 681-2 was an unregulated 20,000 gallon fuel oil tank located on the south side of Building 681. It stored fuel oil for boilers located in Buildings 681 and 680.

Building 680, which is located on the west side of Building 681, was constructed in 1975 and is used for maintenance activities similar to those conducted in Building 681. Engine parts and other equipment were cleaned in dip tanks and/or are sandblasted clean as part of repair and maintenance programs.

Previous Investigations

A summary of investigative activities performed at AOC 681 is presented in Table 4.36.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone I RFI Report*.

Table 4.36.4
Summary of AOC 681 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site soil and groundwater investigation.	
		Round 1 **Soil:** 3 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (681SB001 – 681SB003): VOCs, SVOCs, pesticides, organotins, OP pesticides, PCBs, metals, and cyanide	***Round 1*** **Groundwater:** 3 shallow wells (681001 – 681003): VOCs and SVOCs
Geoprobe Investigation	1995	***Round 2*** **Soil:** 2 surface borings (0 to 1 foot) (681SB004 – 681SB005): VOCs, SVOCs, pesticides, OP pesticides, PCBs, TPH-DRO (1 duplicate collected for Appendix 9 parameters)	***Round 2*** **Groundwater:** 3 shallow wells (681001 – 681003): VOCs, SVOCs, metals, and cyanide
	1998	***Round 3*** **Soil**: No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (681001 – 681002): VOCs, SVOCs, pesticides, PCBs, metals, and cyanide
	1999	***Round 4*** **Soil**: 6 surfaces borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (681SB006 – 681SB011): VOCs, SVOCs, pesticides, PCBs, metals, and cyanide	***Round 4*** **Groundwater:** 3 shallow wells (681001 - 681003): VOCs, SVOCs, metals, cyanide
CH2M-Jones	2001	***Round 5*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (681SB012 – 861SB013): SVOC	***Round 5*** **Groundwater:** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 14 sample locations associated with AOC 681 were evaluated for the presence of contaminants between 1995 and 2001. Of these 14, 10 are within the boundaries of Drainage Basin 49. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of BEQs in subsurface soil and the detection of BEHP in shallow groundwater.

4.36.2 Storm Water Effluent Evaluation

One storm water effluent sample was collected from location 49/5 on March 2, 2002, to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 49 into the Cooper River. Analytical detections for sample EFF057 are presented in Table 4.36.5.

Table 4.36.5
Storm Water Effluent Sampling Results
Drainage Basin 49

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
49	49/5	EFF057	Aluminum	250	3,277	NL	No
			Barium	7.10	60.31	NL	No
			Calcium*	43,000	53,455	NL	No
			Chromium	0.95	13	50	No
			Copper	4.50	41.98	2.90	No
			Iron	190	4,134	NL	No
			Lead	2.40	33.63	8.50	No
			Magnesium*	40,000	49,255	NL	No
			Manganese	9.40	74.52	NL	No
			Potassium*	17,000	23,678	NL	No
			Sodium*	300,000	395,333	NL	No
			Vanadium	3.50	15.59	NL	No
			Zinc	46	307.83	86	No
			Bis(2-Ethylhexyl) phthalate	**0.66**	**NL**	**NL**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.36.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 49. Table 4.36.6 summarizes the migration pathway scenarios.

Table 4.36.6
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 49

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.36.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. The boiler waste water at Facility NS- 44 was typically discharged to the storm water drainage system. Chemicals in the waste were caustic soda, sodium sulfite, disodium phosphate, and cyclohexylamine. The EBS for Facility 680, Fleet Maintenance Building, reported a strong petroleum order coming from a storm water drain north of the facility. The cause for these odors was not known.

Though past practices may make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF057 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at these facilities.

4.36.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 39 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone I background concentrations and the ecological risk-based screening criteria did not identify existing areas which have the potential to provide an upland source of bis (2-ethylhexyl)phthalate in the storm sewer system.

4.36.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 49 were reviewed. The preliminary evaluation identified only one groundwater sample location contaminated with bis(2-ethylhexyl) phthalate within Drainage Basin 49; however, there were no down gradient wells with detections above the screening criteria; therefore, this pathway is considered incomplete.

4.36.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information

obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 49.

4.36.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 49 due to a lack of an upland terrestrial source identification.

4.37 Drainage Basin 51

Drainage Basin 51 encompasses approximately 30 acres within Zones H and I in the southeast section of the CNC. Land cover within the basin consists of approximately 60% unpaved surfaces, 35% paved surfaces, and 5% covered by building foundations. Storm water runoff within the drainage basin is directed to at least one of 25 catch basins connected to storm sewer pipelines that discharge into the Cooper River at Outfall 51.

Figure 4-37 illustrates the area encompassing Drainage Basin 51 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.37.1 Potential Source Areas

A review of the listing of sites found in Appendix A of the Part B Permit indicates there are five SWMUs/AOCs within the boundary of Drainage Basin 51. The sites and their current RFI status are listed in Table 4.37.1. Two sites (AOC 661 and 662) were designated as no further action sites and were not included in the Zone J data evaluation. The remaining three sites include a portion of SWMU 17 (FBM 61, Oil Spill Area), AOC 667 (Vehicle Maintenance Area Building 1776), and SWMU 138 (Satellite Accumulation Area at Building 1776). For this basin assessment, note that the eastern boundary of SWMU 17 transcends the western boundary of Drainage Basin 51; however, the majority of SWMU 17 resides in Drainage Basin 47. Also, due to their proximity to each other, AOC 667 and SWMU 138 are assessed together.

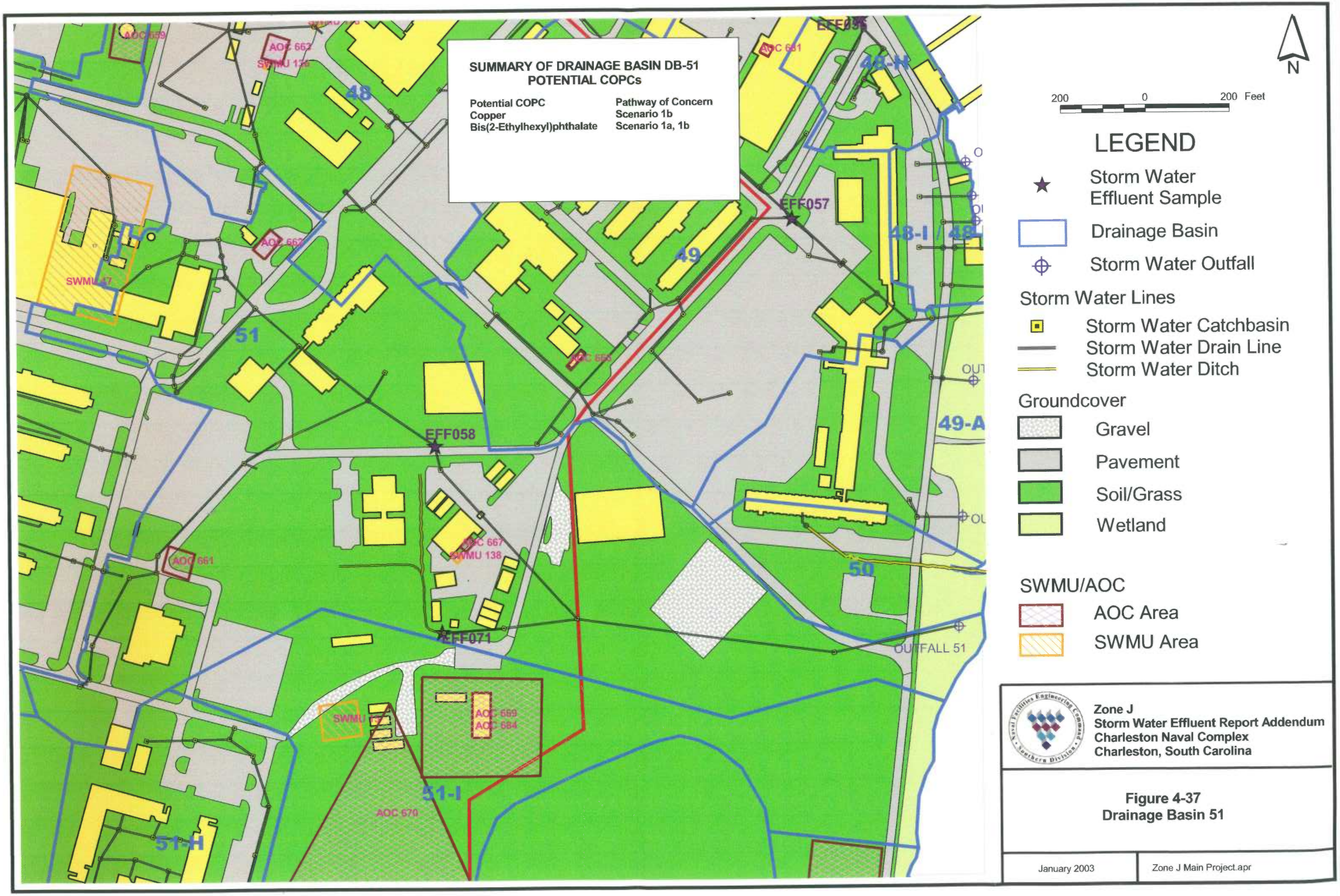
Table 4.37.1
Drainage Basin 51 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 17	Oil Spill Area (part)	Draft RFI Report; RFI Report Addendum Phase II; CMS Work Plan; IM Work Plan
AOC 667/SWMU 138	Vehicle Maintenance Area/Satellite Accumulation Area	Draft RFI Report, RFI Report Addendum Phase II

4.37.1.1 SWMU 17

Site Description and History

SWMU 17 is the approximately 0.75-acre site impacted when an underground pipeline leading to a boiler in Building FBM 61 ruptured in 1987, releasing approximately 14,300 gallons of fuel oil


SUMMARY OF DRAINAGE BASIN DB-51
POTENTIAL COPCs
Potential COPC
Copper
Bis(2-Ethylhexyl)phthalate
Pathway of Concern
Scenario 1b
Scenario 1a, 1b
N
200 0 200 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
48
48-H
48-I / 48-J
49
49-A
50
51
51-H
51-I
EFF057
EFF058
EFF071
OUTFALL 51
AOC 659
AOC 662
SWMU 136
AOC 661
AOC 667
SWMU 138
AOC 669
AOC 684
AOC 670
SWMU 47
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-37
Drainage Basin 51
January 2003
Zone J Main Project.apr

beneath the building. Only a small portion of SWMU 17 is located in Drainage Basin 51 (most is in Drainage Basin 47) with Dyess Avenue bounding the site to the north, Bainbridge Avenue to the south, parking areas to the east, and Buildings 646, 646A, and 647 to the west.

In response to the fuel oil release, the Navy collected soil samples and excavated test pits to assess the impact of the spill. The pits were also used to recover free product from the spill event. Approximately 7,300 gallons of fuel oil was recovered during spill response efforts. PCB contamination was also detected at this site and attributed to PCB transformers previously located near Building FBM 61.

An IM, completed at SWMU 17 by the DET in March 1999, involved the installation of three sumps and two groundwater monitoring wells. After a year of monitoring, the IM removed approximately 45 gallons of oily PCB waste from the sumps (disposed of to a permitted facility) and generated 200 gallons of non-hazardous waste water and 110 gallons of equipment decontamination water (disposed of to the sanitary sewer system).

Previous Investigations

A summary of investigative activities performed at SWMU 17 is presented in Table 4.37.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Final Zone H Report* and *Zone H RFI Report Addendum*.

Table 4.37.2
Summary of SWMU 17 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1994-1999	Site investigation of soil and groundwater.	
	1994	***Round 1*** **Soil:** 11 surface borings (0 to 1 foot) (017SB001 - 017SB011): VOCs, SVOCs, cyanide, metals, TPH, and	***Round 1*** **Groundwater:** 4 shallow wells (017001 – 017004): VOCs, SVOCs, cyanide, metals, TPH,

Table 4.37.2
Summary of SWMU 17 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		pesticides, PCBs. (4 duplicates collected for herbicides, OP pesticides, hexavalent chromium, and dioxins) 9 subsurface borings (3 to 5 feet) (017SB003 – 017SB011): VOCs, SVOCs, cyanide, metals, TPH, and pesticides, PCBs	and pesticides, PCBs
RFI (EnSafe)	1995	***Round 2*** **Soil:** 15 surface borings (0 to 1 foot) (017SB012 - 017SB026): SVOCs, metals, TPH, and PCBs 14 subsurface borings (3 to 5 feet) (017SB012, 017SB015 - 017SB026): SVOCs, metals, TPH, and PCBs	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1995	***Round 3*** **Soil:** 8 surface borings (0 to 1 foot) 7 subsurface borings (3 to 5 feet) (017SB027 – 017SB034): Dioxins, PCBs	***Round 3*** **Groundwater:** 6 shallow wells (017001 – 017006): VOCs, SVOCs, cyanide, metals, and pesticides, PCBs (1 duplicate collected for the same parameters)
RFI (EnSafe)	1995	***Round 4*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (017SB05A – 017SB06A): pH, moisture, general chemistry	***Round 4*** **Groundwater:** 1 shallow well (017002): General chemistry
RFI (EnSafe)	1995	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 7 shallow wells (017001 – 017004, 017FP2): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, and TPH (017005 – 017006): VOCs, SVOCs, metals and general chemistry
RFI (EnSafe)	1996	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 4 shallow wells (017001 – 017004): VOCs, SVOCs, pesticides, PCBs, metals, and TPH
RFI (EnSafe)	1996	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 2 shallow wells (017005 – 017006): VOCs,

Table 4.37.2
Summary of SWMU 17 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			SVOCs, pesticides, PCBs, metals, and Dioxins
MNA (EnSafe)	1998	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** 5 shallow wells (017002 – 017006): VOCs
RFI (EnSafe)	1998	***Round 9*** **Soil:** No Soil Samples Collected.	***Round 9*** **Groundwater:** 10 shallow wells (017001 – 017010): VOCs, SVOCs, pesticides, PCBs, and cyanide
MNA (EnSafe)	1998	***Round 10*** **Soil:** No Soil Samples Collected.	***Round 10*** **Groundwater:** 10 shallow wells (017001 – 017010): VOCs
RFI Addendum (EnSafe)	1999	***Round 11*** **Soil:** 15 surface borings (0 to 1 foot) (017SB035 – 017SB040): PCBs (017SWT01, 017SWT03): VOCs, SVOCs, PCBs (017SWL01 – 017SWL04, 017SWL06): VOCs, SVOCs, PCBs (017SWB02 – 017SWB04): VOCs, SVOCs, PCBs 7 surface borings (0 to 1 foot) (017SWB05 – 017SWB06, 017SWB08 – 017SWB09, 017SWD02, 017SWD04, 017SWL07): VOCs, SVOC, PCBs	***Round 11*** **Groundwater:** 16 shallow wells (017001 – 017002, 017005, 017T01 – 017T03, 017B01 - 017B02, 017B04 – 017B06, 017B08 – 017B09, 017L06, 017W03 - 017W04): VOCs, SVOCs, PCBs
RFI Addendum (EnSafe)	2000	***Round 12*** **Soil:** No Soil Samples Collected.	***Round 12*** **Groundwater:** 10 shallow wells (017001, 017003 – 017004, 017006 – 017010, 017W01 – 017W02): VOCs
RFI (EnSafe)	2000	***Round 13*** **Soil:** No Soil Samples Collected.	***Round 13*** **Groundwater:** 2 shallow wells (017005, 017010): VOCs, SVOCs
Interim Measures (Navy)*	1998-1999	**Soil:** No Soil Samples Collected.	**Groundwater:** Installation of 3 sumps and 2 monitoring wells (017001, 017002) near building; removal of recovered fuel oil. 21 sampling events of sumps and wells over 1 year period; VOCs, SVOCs, metals, and PCBs

Table 4.37.2
Summary of SWMU 17 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CH2M-Jones	2001	***Round 1*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (017SWB02, 017SWT02): VOCs, SVOCs, PCB	***Round 1*** **Groundwater:** 1 shallow well (017005): VOCs, SVOCs
CH2M-Jones	2002	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 8 shallow wells (017005 - 017006, 017008, 017011 – 017012, 017B02, 017B06, 017W02): VOCs, SVOCs, metals, general chemistry, methane, and carbon dioxide

Nature and Extent of Contaminants

Approximately 95 sample locations associated with SWMU 17 were evaluated for the presence of contaminants between 1994 and 2002. Of these 95, approximately 25 locations are within the boundaries of Drainage Basin 51. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of the LNAPL (chlorobenzene is the primary CoC) and DNAPL (Aroclor 1260 is the primary CoC) in groundwater and Aroclor 1260 in the surface soil. The light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) detections at SWMU 17 are not associated with Drainage Basin 51.

4.37.1.2 AOC 667 / SWMU 138

Site Description and History

AOC 667 is the vehicle maintenance area at Building 1776, which once operated an oil-water separator and portable 550-gallon AST for maintenance of automobiles and heavy equipment. SWMU 138 is a Satellite Accumulation Area adjacent to Building 1776 which accumulated hazardous waste in 55-gallon drums before transfer to a permitted hazardous waste storage facility.

Previous Investigations

For AOC 667/SWMU 138, the RFI is the only investigation that has been conducted for this site. A summary of investigative activities is presented in Table 4.37.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during the investigation. Detailed discussions and results prior to 2000 are presented in the Final Zone H RFI Report and Zone H RFI Report Addendum .

Table 4.37.3
Summary of AOC 667/SWMU 138 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil and groundwater	
		Round 1 **Soil:** 7 surface borings (0 to 1 foot) 7 subsurface borings (3 to 5 feet) (667SB001 - 667SB004 and 138SB001 - 138SB003): VOCs, SVOCs, pesticides, PCBs metals, cyanide, TPH (2 duplicates collected for herbicides, hexavalent chromium, dioxins, and OP pesticides)	***Round 1*** **Groundwater:** 2 shallow wells (667001, 667002): VOCs, SVOCs, pesticides, PCBs metals, and cyanide
RFI (EnSafe)	1995	***Round 2*** **Soil:** No Soil Samples Collected.	***Round 2*** **Groundwater:** 2 shallow wells (667001, 667002): VOCs and metals (1 duplicate collected for same parameters)
RFI (EnSafe)	1995	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 2 shallow wells (667001, 667002): VOCs and metals (1 duplicate collected for same parameters)
RFI (EnSafe)	1995	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 2 shallow wells (667001, 667002): VOCs and metals (1 duplicate collected for same parameters)
RFI Addendum	1999-2000	Implemented to address data gaps and further delineate contamination boundaries at the	

Table 4.37.3
Summary of AOC 667/SWMU 138 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
		site.	
		Round 5 **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 2 shallow wells (667001, 667002): VOCs
RFI Addendum	1999-2000	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 2 shallow wells (667001, 667002): VOCs
CH2M-Jones	2002	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 3 shallow wells (667001-667003): SVOCs

Nature and Extent of Contaminants

Approximately ten sample locations associated with AOC 667/SWMU 138 were evaluated for the presence of contaminants between 1995 and 2002. All sample locations are within the boundaries of Drainage Basin 51. Surface, subsurface and groundwater samples were collected and analyzed for various constituents in order to determine if releases associated with petroleum product storage and dispensing, as well as any other releases, had occurred at the site. Of primary interest were detections of 1,1-dichloroethane, 1,2-dichloroethane (total), chloroethane, and carbon disulfide in site groundwater wells. Although initially, none of these constituents exceeded USEPA Region III tap water RBCs or MCLs, subsequent revisions to the RBCs resulted in an exceedance of chloroethane in groundwater at the site, triggering further investigation. Upon completion of sampling activities in 2000, the presence of chloroethane in groundwater was deemed insignificant due to the localized nature of the contamination and the fact that chloroethane eventually degrades to inorganic salts, carbon dioxide and water.

4.37.2 Storm Water Effluent Evaluation

Two storm water effluent samples were collected from manhole 51/4 on January 25, 2002 and a drainage ditch on July 15, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 51 into the Cooper River. Analytical detections for samples EFF058 and EFF071 are presented in Table 4.37.4.

Table 4.37.4
Storm Water Effluent Sampling Results
Drainage Basin 51

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
51	51/4	EFF058	Aluminum	240	3,277	NL	No
			Barium	13	60.31	NL	No
			Calcium*	61,000	53,455	NL	No
			Chromium	2.00	13	50	No
			Copper	6.50	41.98	2.90	No
			Iron	290	4,134	NL	No
			Magnesium*	47,000	49,255	NL	No
			Manganese	49	74.52	NL	No
			Nickel	2.00	5.14	8.30	No
			Potassium*	24,000	23,678	NL	No
			Sodium*	310,000	395,333	NL	No
			Vanadium	3.40	15.59	NL	No
			Zinc	110	307.83	86	No
			Acenaphthene	6.40	NL	9.70	No
			bis(2-Ethylhexyl) phthalate	**1.10**	**NL**	**NL**	**Yes**
			Dibenzofuran	0.94	NL	NL	No
			Fluoranthene	1.70	NL	1.60	No
			Fluorene	**0.40**	**NL**	**NL**	**Yes**
			Pyrene	**0.97**	**NL**	**NL**	**Yes**
51	51-Ditch	EFF071	Aluminum	1,500	3,277	NL	No
			Antimony	**9.50**	**5.93**	**NL**	**Yes**
			Arsenic	8.10	6.88	36	No
			Barium	14	60.31	NL	No
			Calcium*	43,000	53,455	NL	No

Table 4.37.4
Storm Water Effluent Sampling Results
Drainage Basin 51

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Chronic Saltwater Screening Value	Potential COPC
			Chromium	5.00	13	50	No
			Cobalt	1.20	2.00	NL	No
			Copper	**5,000**	**41.98**	**2.90**	**Yes**
			Iron	3,900	4,134	NL	No
			Magnesium*	29,000	49,255	NL	No
			Manganese	1,200	74.52	NL	No
			Nickel	**46**	**5.14**	**8.30**	**Yes**
			Potassium*	19,000	23,678	NL	No
			Silver	2.00	2.34	0.23	No
			Sodium*	230,000	395,333	NL	No
			Vanadium	9.50	15.59	NL	No
			Zinc	260	307.83	86	No
			Di-n-butylphthalate	0.34	NL	3.40	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.37.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and to determine the applicability of each scenario to Drainage Basin 51. Table 4.37.5 summarizes the migration pathway scenarios.

Table 4.37.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 51

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No

Table 4.37.5
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 51

Scenario	Pathway Description	Is Pathway Complete?
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system→Zone J	No

4.37.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. The boiler waste water at Facility 654, Personnel Support Detachment building, was typically discharged to the storm water drainage system. Chemicals in the waste were caustic soda, sodium sulfite, disodium phosphate, and cyclohexylamine. Environmental Incident Report # 87-50 reported 14,355 gallons of #5 fuel oil were released into the environment from a ruptured fuel line at Facility FBM61, the Fleet Ballistic Missile Submarine Training Center. Approximately 1,200 gallons of the fuel oil was discharged into the Cooper River via the storm water sewer system.

There is possible linkage evidence between the FBM61 release and the effluent PAH data for EFF058. Further assessment of the data is warranted during the COPC refinement process to determine if the low concentrations of the PAHs detected in the effluent will necessitate a SLERA.

4.37.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 25 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone H background concentrations and the ecological risk based screening criteria identified seven existing areas which have the potential to provide an upland source of COPCs identified in

Table 4.37.4 in the storm sewer system. Table 4.37.6 summarizes the sample locations that may provide a possible linkage.

4.37.6
Drainage Basin 51
Scenario 1b Catch Basin Evaluation
Charleston Naval Complex, South Carolina

Catch Basin	Sample ID	Surface Soil COPC	Concentration (mg/kg)	Screening Value (mg/kg)	Distance (ft) to Catch Basin
51/6	017SB011	bis (2-Ethylhexyl) phthalate	0.228	0.182 (SSV)	265
51/6	017SB022	bis(2-Ethylhexyl) phthalate	0.26	0.182 (SSV)	250
		Copper	43.6	24 (BKG)	
51/6	017SB024	bis (2-Ethylhexyl) phthalate	0.67	0.182 (SSV)	325
51/6	017SB025	bis (2-Ethylhexyl) phthalate	0.25	0.182 (SSV)	209
51/6	017SB023	Copper	49.4	24 (BKG)	294
51/2A	667SB001*	bis (2-Ethylhexyl) phthalate	0.31	0.182 (SSV)	301
51/2A	667SB002*	bis (2-Ethylhexyl) phthalate	0.46	0.182 (SSV)	289

Notes:
* = Sample location is located under pavement and constituents from these locations most likely do not represent complete exposure pathways to the storm water system.

Evaluation of surface soil data to determine possible upland terrestrial source identification with EFF051 COPCs revealed that copper and bis (2-Ethylhexyl)phthalate were detected in surface soil above screening criteria at locations from 209 to 325 feet from catch basins within Drainage Basin 51. Figure 4-37A illustrates the sample locations where a possible linkage may exist.

4.37.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are

100 0 100 Feet

N

LEGEND

- Soil Linkage Sample
- Surface Soil Sample
- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-37A
Drainage Basin 51
Soil Sample Linkage Locations

November 2002 | Zone J Main Project.apr

present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 51 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with COPCs identified in Table 4.37.4 intercepting the storm water drainage pipeline within Drainage Basin 51.

4.37.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 51.

4.37.4 Summary of Potential COPCs

Table 4.37.7 summarizes the potential COPCs that have been included for further characterization during the COPC Refinement process for the Cooper River for Drainage Basin 51.

Table 4.37.7
Summary of Potential COPCs
Drainage Basin 51

Potential COPC	Pathway of Concern
Copper	Scenario 1b
bis(2-Ethylhexyl) phthalate	Scenario 1a Scenario 1b

4.38 Drainage Basin 51C

Drainage Basin 51C encompasses approximately 9.17 acres within Zone I in the south section of the CNC and is the area surrounding ammunition bunker X-55. Land cover within the drainage basins consists of approximately 90% unpaved surfaces, 5% paved surfaces and 5% building foundations. The combined drainage basin is bordered to the east by the Cooper River, to the west by the DMA, to the north by several small buildings, and to the south by ammunition bunker X-56. Storm water runoff within the drainage basin west of Juneau Avenue is directed to a storm water drainage ditch which parallels Juneau Avenue and is connected to Outfall 51C by a culvert. Storm water runs off east of Juneau Avenue is directly to the Cooper River.

Figure 4-38 illustrates the area encompassing Drainage Basin 51C and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.38.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates there are two SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 51C. Two sites are listed in Table 4.38.1 along with current status. These potential source areas are AOCs 687 and SWMU 16 which were investigated as a combined AOC/SWMU.

Table 4.38.1
Drainage Basin 51C SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
SWMU 16	Paint Storage Bunker	Draft Zone I RFI Report; CMS Work Plan; NFA
AOC 687	Ammunition Storage Bunker (X-55)	Draft Zone I RFI Report; CMS Work Plan; NFA

4.38.1.1 SWMU 16/AOC 687
Site Description and History

SWMU 16 is the earth covered roof of Building X-55 and is associated with AOC 687 due to unauthorized storage of potentially hazardous material (empty paint containers). Paint container storage was identified as a one-time occurrence and is not thought to be a historical problem. Removal of the containers and clean up of minor spills associated with storage of the paint containers were completed at the time of discovery.

SWMU 14
AOC 685
51-A
OUTFALL 51A
X54
51-B
OUTFALL 51B
51-C
SWMU 16
AOC 687
EFF059
OUTFALL 51C
EFF060
OUTFALL 51D
51-D
AOC 688
EFF061
OUTFALL 51E
51-E
N
200 0 200 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-38
Drainage Basin 51C
November 2002
Zone J Main Project.apr

AOC 687 consists of Building X-55, an earth-covered ammunition storage bunker constructed in 1942. The building appears to have been used for ammunition storage since construction of the bunker. Explosives were identified as materials of concern in the final RFI work plan.

Previous Investigations

A summary of investigative activities performed at SWMU 16/AOC 687 is presented in Table 4.38.2 as they were investigated as a combined AOC/SWMU. Detailed discussions and results are presented in the *Final Zone I RFI Report*.

Table 4.38.2
Summary of SWMU 16/AOC 687 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1995	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (687SB001- 687SB004): organotins, VOCs, SVOCs, pesticides, PCBs, metals, cyanide (1 duplicate collected for same parameters)	***Round 1*** **Groundwater:** 4 shallow wells (687001- 687004): organotins, VOCs, SVOCs, pesticides, PCBs, metals, cyanide, chloride, sulfate, TDS
RFI (EnSafe)	1996	***Rounds 2 and 3*** **Soil:** No Soil Samples Collected.	***Rounds 2 and 3*** **Groundwater:**. 4 shallow wells (687001 - 687003): cyanide, metals (687004): cyanide, metals, chloride, sulfate, and TDS.
RFI (EnSafe)	1996	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 4 shallow wells (687001-687004): VOCs, TDS, chloride, sulfate, cyanide, metals, pesticides and PCBs.
RFI (EnSafe)	1998	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 4 shallow wells (687001- 687004): VOCs, metals
RFI (EnSafe)	1998	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 4 shallow wells (687001-687004): VOCs, SVOCs, metals.

Nature and Extent of Contaminants

Eight sample locations associated with AOC 687 were evaluated for the presence of contaminants between 1995 and 1998. No soil borings were advanced specifically for SWMU 16 because paint container storage was identified as a one-time event and not a long-term occurrence. All sample locations are within the boundaries of Drainage Basin 51C. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to the munitions storage at X-55. Of particular interest were detections of BEQs, chlordane, and chromium in the soil.

4.38.2 Storm Water Effluent Evaluation

Storm water effluent samples were collected at the entry point of the culvert passing beneath the south entrance of the unpaved perimeter road around the X-51 fenced enclosure on August 30, 2002, to determine if constituents are migrating from the AOCs and SWMUs associated with Drainage Basin 51C into the Cooper River. Analytical detections for sample EFF059 are presented in Table 4.38.3.

Table 4.38.3
Storm Water Effluent Sampling Results
Drainage Basins 51C

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
51C	51C	EFF059	**Aluminum**	**3,600**	**3,277**	**NL**	**Yes**
			Arsenic	5.90	6.88	36	No
			Barium	7.30	60.31	NL	No
			Calcium*	28,000	53,455	NL	No
			Chromium	5.50	13	50	No
			Copper	10	41.98	2.90	No
			Iron	2,000	4,134	NL	No
			Magnesium*	13,000	49,255	NL	No
			Manganese	64	74.52	NL	No
			Nickel	4.20	5.14	8.30	No
			Potassium*	18,000	23,678	NL	No
			Sodium*	130,000	395,333	NL	No

Table 4.38.3
Storm Water Effluent Sampling Results
Drainage Basins 51C

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (µg/L)	Screening Value (µg/L) Reference Concentration	Screening Value (µg/L) Chronic Saltwater Screening Value	Potential COPC
			Vanadium	14	15.59	NL	No
			Zinc	18	307.83	86	No

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.38.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Report* and to determine the applicability of each scenario to Drainage Basin 51C. The Zone J data evaluation resulted in three possible outcomes based on the available data present for Drainage Basins 51C. Table 4.38.4 summarizes the migration pathway scenarios.

Table 4.38.4
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 51C

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	No
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system →Zone J	No

4.38.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. No releases impacting the storm water sewer system within the boundaries of Drainage Basin 3 were discovered during review of environmental incident reports that were maintained by the former CNSY Environmental Office Code 106 between the time period from 1982 until base closure in 1996,

and EBS reports prepared for property transfer. Therefore, this pathway is considered incomplete.

4.38.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that the open storm water drainage ditch is near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone I background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source of aluminum in the storm sewer system.

4.38.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 51C were reviewed. The preliminary evaluation did not identify any groundwater contaminated with aluminum intercepting the storm water drainage pipeline within Drainage Basin 51C.

4.38.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* (EnSafe, December 1998) indicates that there are no cross-connects present in Drainage Basin 51C.

4.38.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 51C due to a lack of upland terrestrial source identification.

4.39 Drainage Basin 53

Drainage Basin 53 encompasses approximately 10 acres within Zone F in the central section of the CNC. Land cover within the drainage basin consists of approximately 20% unpaved surfaces (i.e., mostly grass), 45% paved surfaces and 35% building foundations. Storm water runoff within the drainage basin is directed to at least one of 15 catch basins or a series of drainage ditches that discharge to the Cooper River via Outfall 53.

Figure 4-39 illustrates the area encompassing Drainage Basin 53 and associated RCRA sites, storm water effluent locations and storm water drainage features.

4.39.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates that there are three SWMUs/AOCs that are partly or completely within the boundary of Drainage Basin 53. Each site is listed in Table 4.39.1 along with its current status. The potential source areas include AOC 607 (Building 1189 Dry Cleaning), AOC 609 (Building 1346 Gas Station) and AOC 611 (Grease Rack and Hobby Shop). Note for this assessment that a northern portion of AOC 609 transcends the boundary of Drainage Basin 53 with the majority of the site residing in Drainage Basin 37 and Drainage Basin 43. The majority of AOC 607 is in Drainage Basin 37. Also note that the southwestern corner of AOC 611 transcends the boundary of Drainage Basin 53 into Drainage Basin 37; however, the majority of AOC 611 resides in Drainage Basin 53.

Table 4.39.1
Drainage Basin 53 SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 607	Building 1189 Dry Cleaning	Draft RFI Report; RFI Work Plan Addendum; IM Phase II Work Plan; IM Phase III Work Plan
AOC 609	Building 1346 Gas Station	Draft RFI Report; RFI Report Addendum; NFA
AOC 611	Grease Rack and Hobby Shop	Draft RFI Report, RFI Report Addendum

N

200 0 200 Feet

LEGEND

- Storm Water Effluent Sample
- Drainage Basin
- Storm Water Outfall

Storm Water Lines

- Storm Water Catchbasin
- Storm Water Drain Line
- Storm Water Ditch

Groundcover

- Gravel
- Pavement
- Soil/Grass
- Wetland

SWMU/AOC

- AOC Area
- SWMU Area

Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina

Figure 4-39
Drainage Basin 53

July 2003 | Zone J Main Project.apr

4.39.1.1 AOC 607

Site Description and History

An RFI site, AOC 607 is the former dry-cleaning facility at Building 1189, which operated from 1942 to 1986. From 1986, the facility was used as a laundry, housing two industrial washers and dryers. While operating as a dry-cleaning establishment, the facility was classified as a minor emitter of total hydrocarbons. Materials released, stored, or disposed of at the site included perchlorethylene solvent.

Previous Investigations

A summary of investigative activities performed at AOC 607 is presented in Table 4.39.2, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone F RFI Report*.

Table 4.39.2
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (607SB001 – 607SB004); SVOCs, VOCs, metals	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 2*** **Soil:** 6 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (607SB005 – 607SB010); SVOCs, VOCs, metals	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996	***Round 3*** **Soil:** No Soil Samples Collected.	***Round 3*** **Groundwater:** 6 shallow wells (607001 -607004, 607006, 607007): metals, SVOCs, and VOCs

Table 4.39.2
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1997	***Round 4*** **Soil:** No Soil Samples Collected.	***Round 4*** **Groundwater:** 8 shallow wells (607001 – 607004, 607006 - 607007): SVOCs, VOCs, and metals (607008): VOCs (607009): SVOCs, VOCs, and metals
RFI (EnSafe)	1997	***Round 5*** **Soil:** No Soil Samples Collected.	***Round 5*** **Groundwater:** 2 shallow wells (607006 and 607008): VOCs
RFI (EnSafe)	1997	***Round 6*** **Soil:** No Soil Samples Collected.	***Round 6*** **Groundwater:** 7 shallow wells (607001 - 607004, 607006 - 607008): VOCs, SVOCs, and metals
RFI (EnSafe)	1997	***Round 7*** **Soil:** No Soil Samples Collected.	***Round 7*** **Groundwater:** 1 shallow wells (607009): VOCs, SVOCs, and metals
RFI (EnSafe)	1997	***Round 8*** **Soil:** No Soil Samples Collected.	***Round 8*** **Groundwater:** 10 shallow wells (607001 - 607004, 607006 - 607009): VOCs, SVOCs, and metals
RFI (EnSafe)	1998	***Round 9*** **Soil:** No Soil Samples Collected.	***Round 9*** **Groundwater:** 2 shallow wells (607008, 607009): VOCs, SVOCs, and metals
RFI (EnSafe)	1998	***Round 10*** **Soil:** No Soil Samples Collected.	***Round 10*** **Groundwater:** 8 shallow wells (607001 through 607004, and 607006 through 607009): VOCs, SVOCs, and metals
RFI (EnSafe)	1998	***Round 11*** **Soil:** No Soil Samples Collected.	***Round 11*** **Groundwater:** 8 shallow wells (607001 through 607004, 607006 through 607009): VOCs

Table 4.39.2
Summary of AOC 607 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1998	***Round 12*** **Soil:** 7 surface borings (0 to 1 foot) (607SB01101 – 607SB01801): VOCs	***Round 12*** **Groundwater:** 8 shallow wells (607010 through 607017): VOCs
RFI (EnSafe)	1999	***Round 13*** **Soil:** No Soil Samples Collected.	***Round 13*** **Groundwater:** 16 shallow wells (607001 through 607004, and 607006 through 607017): VOCs
RFI (EnSafe)	1999	***Round 14*** **Soil:** No Soil Samples Collected.	***Round 14*** **Groundwater:** 16 shallow wells (607001 through 607004, and 607006 through 607017): VOCs
RFI (EnSafe)	1999	***Round 15*** **Soil:** No Soil Samples Collected.	***Round 15*** **Groundwater:** 16 shallow wells (607GW001C4 through 607GW004C4, and 607GW006C4 through 607GW017C4): VOCs
RFI (EnSafe)	1999	***Round 16*** **Soil:** 6 surface borings (0 to 1 foot) 6 subsurface borings (3 to 5 feet) (607SB008S1 – 607SB008S2, 607SB010S1 – 607SB010S2, 607SB016S1 – 607SB016S2): SVOCs, VOCs, metals, cyanide, pesticides, and PCBs (607SB008T1 – 607SB008T2, 607SB010T1 – 607SB010T2, 607SB016T1 – 607SB016T2): SVOCs, VOCs, metals, cyanide, pesticides, PCBs, and TOC Exception: 607SB008T2 and 607SB016T2 not analyzed for VOCs	***Round 16*** **Groundwater:** 18 shallow wells (607GW001C5 through 607GW004C5, 607GW006C5 through 607GW017C5): (607GW002C5b): Lead (607GW009A5): metals
RFI (EnSafe)	2000	***Round 17*** **Soil:** No soil samples were collected.	***Round 17*** **Groundwater:** 4 shallow wells (607G000110, 607G000310, 607G000410, 607G000910): VOCs

Nature and Extent of Contaminants

Approximately 170 sample locations associated with AOC 607 were evaluated for the presence of contaminants between 1996 and 2000. Of these 170, approximately three sample locations (groundwater wells, two deep, one shallow) are within the boundaries of Drainage Basin 53. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of vinyl chloride and aluminum in surface soil and tetrachloroethene, vinyl chloride, trichloroethene, arsenic, and trichloride in shallow groundwater. Based on analytical results, a CMS was recommended for shallow groundwater at AOC 607.

4.39.1.2 AOC 609

Site Description and History

AOC 609 is the former gasoline station, automotive repair and maintenance shop at Building 1346, which was built in 1962. The focus of the RFI is the waste oil UST at Building 1346. Materials released, stored or disposed of at the site included gasoline, diesel fuel, motor/lubricating oils, degreasing solvents, antifreeze and various automotive products.

This site contained USTs which contained gasoline and diesel fuel. Three of the original nine steel USTs were found to be leaking in 1991 and were removed. They were replaced with fiberglass tanks in 1992. Subsequently, six monitoring wells (Three within Drainage Basin 53) were installed by S&ME, Inc., to define the horizontal and vertical extent of groundwater contamination. The assessment report submitted to SCDHEC in February, 1993, resulted in the installation of two additional perimeter wells near the site. All site wells were re-sampled in November, 1994, with the results confirming previous findings. A source well near the site exhibited concentrations of benzene (36,100 µg/L), toluene (47,800 µg/L), ethylbenzene (3,620 µg/L), xylene (16,800 µg/L) and methyl tertiary butyl ether (62,200 µg/L). All perimeter wells were below detection limits for the same parameters. A free-product recovery system installed in 1995 is still in operation. This investigation activity was reported in the *Assessment Report Addendum Building No. 1346, Charleston Naval Base, Charleston, SC* (S&ME, March 29, 1995), prepared for the Navy Public Works Center Jacksonville, Charleston Zone.

The 560-gallon steel waste oil UST on the west side of the building being assessed in this RFI was removed in 1996. This tank received waste oil from floor drains in the maintenance garage, and was periodically emptied by suctioning to a waste oil truck. This removal was performed by the Supervisor of Shipbuilding, Conversion and Repair, USN, Portsmouth Detachment Environmental, Charleston, SC.

Previous Investigations

A summary of investigative activities performed at AOC 609 is presented in Table 4.39.3, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations, and analytical methods performed during each phase of the investigation. Detailed discussions and results are presented in the *Final Zone F RFI.*

Table 4.39.3
Summary of AOC 609 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 – 1997	Site investigation of soil and groundwater.	
	1996	***Round 1*** **Soil:** 6 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (609SB00101 – 609SB00502): SVOCs, VOCs, and metals	***Round 1*** **Groundwater:** 3 shallow wells (SME00101, SMEGW00501-SMWGW00601): metals, pesticides, PCBs, SVOCs, VOCs
RFI (EnSafe)	1997	***Round 2*** **Soil:** 1 surface boring (0 to 1 foot) (609SB003P1): pH, TOC, and cation exchange	***Round 2*** **Groundwater:** 3 shallow wells – 3 rounds of data collected (SMEGW00101, SMEGW00501-SMEGW00601): metals, pesticides, PCBs, SVOCs, VOCs
RFI (EnSafe)	1999	***Round 3*** **Soil:** No soil samples were collected	***Round 3*** **Groundwater:** 2 shallow wells (609GW00101 – 609GW00201): SVOCs, VOCs, metals, pesticides, and PCBs
RFI (EnSafe)	1999	***Round 4*** **Soil:** 10 surface borings (0 to 1 foot) 10 subsurface borings (3 to 5 feet) (609SB00801 – 609SB01202): metals (609SB001S1 – 609SB002S2): SVOCs,	***Round 4*** **Groundwater:** 2 shallow wells (609GW00102 – 609GW00202): VOCs and metals

Table 4.39.3
Summary of AOC 609 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations
		VOCs, metals, pesticides, PCBs, and cyanide (609SB001T1 – 609SB002T2): SVOCs, VOCs, metals, pesticides, PCBs, cyanide, and TOC

Nature and Extent of Contaminants

Approximately 35 sample locations associated with AOC 609 were evaluated for the presence of contaminants between 1996 and 1999. Of these 35, five sample locations (all groundwater wells) are within the boundaries of Drainage Basin 53. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were the detections of arsenic, beryllium, BEQs, antimony, and manganese in surface soil, and benzene, arsenic, toluene, and 4-methyl phenol in shallow groundwater.

4.39.1.3 SWMU 611

Site Description and History

AOC 611 is the former site of Building 1264, a small, garage type structure used as an automotive hobby shop from the late 1950s to the early 1960s. The building has been demolished and the site incorporated into a partially asphalt paved and grass covered area. Materials potentially stored, released or disposed of at the site include petroleum products, antifreeze, isopropyl alcohol, solvents, degreasers, enamel paint, paint thinner, battery acid, and lead.

An IM was performed at the site by SPORTENDETCHASN in 1998. The objective of the removal action was to mitigate risks associated with PAHs and arsenic contamination identified at the site during the initial RFI. IM activities resulted in the removal of approximately 280 cubic yards of impacted soil from the site. According to the *Final Zone F Work Plan Addendum*, the objective of the IM effort was met.

Previous Investigations

A summary of investigative activities performed at AOC 611 is presented in Table 4.39.4, which contains the date of the activities, number of soil and shallow groundwater samples collected, sample locations and analytical methods performed during each phase of the investigation. Detailed discussions and results prior to 2000 are presented in the *Draft Zone F RFI Report* and the *Final Zone F Work Plan Addendum*.

Table 4.39.4
Summary of AOC 611 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1996 -1999	Site soil investigation	
		Round 1 **Soil:** 4 surface borings (0 to 1 foot) 4 subsurface borings (3 to 5 feet) (611SB001 – 611SB004): VOCs, SVOCs, metals, and pH	***Round 1*** **Groundwater:** No Groundwater Samples Collected.
RFI (EnSafe)	1996-1997	***Round 2*** **Soil:** 3 surface borings (0 to 1 foot) 3 subsurface borings (3 to 5 feet) (611SB005 – 611SB007): SVOCs and metals (1 duplicate sample collected for same parameters plus VOCS, pesticides, PCBs, herbicides, OP pesticides, hexavalent chromium, cyanide, and dioxins)	***Round 2*** **Groundwater:** No Groundwater Samples Collected.
IM (DET)	1998	Performed to excavate and remove arsenic and BEQ impacted soils at levels exceeding RBCs. A total of 4 confirmation samples were collected. According to the Final Zone F Work Plan Addendum, the objective was met.	
RFI (EnSafe)	1999	***Round 3*** 5 surface borings (0 to 1 foot) 5 subsurface borings (3 to 5 feet) (611SB008 – 611SB012): metals (3 duplicates for same parameters)	***Round 3*** No Groundwater Samples Collected.
RFI (EnSafe)	1999	***Round 4*** **Soil:** 2 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (611SB013 – 611SB014): metals	***Round 4*** **Groundwater:** No Groundwater Samples Collected.

Table 4.39.4
Summary of AOC 611 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
CH2M-Jones	2001	***Round 5*** **Soil:** 5 surface borings (0 to 1 foot) 2 subsurface borings (3 to 5 feet) (611SB017-611SB021): PCBs, SVOCs, lead	***Round 5*** No Groundwater Samples Collected.
CH2M-Jones	2001	***Round 5*** **Soil:** 16 surface borings (0 to 1 foot) 16 subsurface borings (3 to 5 feet) (U25SB020-U25SB035): SVOCs, VOCs	***Round 5*** No Groundwater Samples Collected.

Nature and Extent of Contaminants

Approximately 55 sample locations associated with AOC 611 were evaluated for the presence of contaminants between 1996 and 1999. All sample locations are within the boundaries of Drainage Basin 53. Surface and subsurface soil samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination at the site. Of particular interest were detections of arsenic, BEQs, chromium, and mercury in surface soil.

4.39.2 Storm Water Effluent Evaluation

Storm water effluent samples were collected at manhole 53 on May 18, 2002 to determine if constituents are migrating from the SWMUs/AOCs associated with Drainage Basin 53 into the Cooper River. Analytical detections for sample EFF070 are presented in Table 4.39.5.

Table 4.39.5
Storm Water Effluent Sampling Results
Drainage Basin 53

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Saltwater Screening Value	Potential COPC
53	53	EFF070	Aluminum	480	3,277	NL	No
			Arsenic	11.15	6.88	36	No
			Barium	11.85	60.31	NL	No
			Calcium*	21,000	53,455	NL	No
			Chromium	6.25	13.00	50	No

Table 4.39.5
Storm Water Effluent Sampling Results
Drainage Basin 53

Drainage Basin	Catch Basin/ Manhole ID	Sample ID	Parameter	Concentration (μg/L)	Screening Value (μg/L) Reference Concentration	Screening Value (μg/L) Saltwater Screening Value	Potential COPC
			Copper	12	41.98	2.90	No
			Iron	1,050	4,134	NL	No
			Lead	8.00	33.63	8.50	No
			Magnesium*	6,050	49,255	NL	No
			Manganese	**76**	**74.52**	**NL**	**Yes**
			Potassium*	5,550	23,678	NL	No
			Sodium*	46,500	395,333	NL	No
			Vanadium	7.75	15.59	NL	No
			Zinc	99	307.83	86	No
			beta-BHC	**0.0076**	**NL**	**NL**	**Yes**
			gamma-BHC	**0.025**	**NL**	**0.016**	**Yes**
			Heptachlor	**0.0086**	**NL**	**0.0036**	**Yes**

Notes:
* = Parameter is considered an essential nutrient; therefore, it will not be evaluated as a potential COPC.

4.39.3 Pathway Evaluation

Data collected during the investigative activities summarized above were used to evaluate the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and determine the applicability of each scenario to Drainage Basin 53. The Zone J data evaluation resulted in three possible outcomes based on the available data present for Drainage Basin 53. Table 4.39.6 summarizes the migration pathway scenarios.

Table 4.39.6
Storm Water Contaminant Migration Pathway Scenario Summary
Drainage Basin 53

Scenario	Pathway Description	Is Pathway Complete?
1a	waste→catch basin→storm water drainage pipeline→Zone J	Yes
1b	waste in sheet flow→catch basin→storm water drainage pipeline→Zone J	No
1c	storm water drainage pipeline intercepting contaminated groundwater (infiltration)→Zone J	No
1d	cross connect exists from the sanitary sewer system to the storm sewer system →Zone J	No

4.39.3.1 Scenario 1a

Scenario 1a evaluates the direct release of waste into a catch basin which subsequently travels through the storm water drainage pipeline into Zone J water bodies. According to the EBS (EnSafe, 1995), seven buildings (NH-52, NH-54, NH-72, NH-1137, NH-1150, 81) were identified with the possible release of boiler blowdown into the storm water sewer system. The following chemicals may have been used for the treatment of water in the boiler used at these facilities: caustic soda, sodium, sulfite, disodium phosphate, and cyclohexylamine. Boiler waste water containing these chemicals is typically discharged to the storm water sewer system according to Public Works Utilities Department personnel. In 1990, two gallons of POL were released in the vicinity of Building 223 according to Environmental Incident Report #90-47. Building 223 is located within the boundaries of Drainage Basins 20 and 22 and it was not known at the time of the release if any of the release reached the storm water sewer system. Another facility within Drainage Basin 53, NSC 66, stored submarine and ship parts and according to the EBS a Hazardous Materials Report stated that blasting grit was packed in the storm drains and subsequently the areas were cleaned up. Though past practices make this scenario complete, a review of historical information, RFI data, current site use, and the storm water effluent data from EFF014 do not presently identify contaminants that may be associated with past practices relating to direct releases of waste at this facility.

4.39.3.2 Scenario 1b

Scenario 1b evaluates movement of contaminants via sheet flow to catch basins, transport of those chemicals from catch basins to storm water drainage pipelines and release into Zone J water bodies from drainage basin outfalls. The pathway evaluation shows that one of 15 catch basins are near surface soil sample locations associated with existing SWMUs or AOCs.

Comparison of the analytical results from surface soil samples near these drainage features to Zone F background concentrations and the ecological risk based screening criteria did not identify existing areas which have the potential to provide an upland source of manganese, beta-BHC, gamma-BHC, or heptachlor, in the storm sewer system.

4.39.3.3 Scenario 1c

Scenario 1c evaluates storm water drainage pipeline intercepting contaminated groundwater (infiltration) which discharges to Zone J water bodies. Potential COPCs were identified if constituent concentrations exceeded Zone J screening criteria in the downgradient well(s) and were identified on both sides of a storm water sewer line. When potential COPCs were identified the maximum values were presented for the evaluation process. This is a conservative approach that will identify potentially problematic areas for a more detailed assessment, which includes reviewing groundwater flow patterns to see if localized groundwater depressions are present, which could indicate an area where infiltration is occurring, long term trends in the data sets, data from surrounding well points, etc. All rounds of groundwater data collected within Drainage Basin 53 were reviewed. The preliminary evaluation did not identify any groundwater contaminated with manganese, beta-BHC, gamma-BHC, or heptachlor, intercepting the storm water drainage pipeline within Drainage Basin 53.

4.39.3.4 Scenario 1d

Scenario 1d evaluates if cross connects exist between the sanitary and storm sewer systems, thereby identifying a possible pathway for waste to enter Zone J water bodies. Information obtained from the Davis and Floyd Study and the *Zone L RFI Report* indicates that there are no cross-connects present in Drainage Basin 53.

4.39.4 Summary of Potential COPCs

There are no potential COPCs for Drainage Basin 53 due to a lack of an upland terrestrial source identification.

4.40 Clouter Island

Clouter Island is located on the east bank of the Cooper River east of CNC and consists of four dredge spoil cells, of which three were owned by the Navy. The northern portion of the island is owned by the South Carolina State Ports Authority and is utilized by the USACE. The portion of Clouter Island and associated facilities owned by the Navy were transferred to the USACE in 1996. Dredge spoils are slurried from the Cooper River to the island to maintain the Cooper River ship channel. A former ammunition depot operated by the Navy was located at the southwestern corner of Clouter Island from the early 1920s to 1940s. The ammunition depot was used to store various types of military ordnance. The former storage buildings have since been removed with the foundations for these buildings left in place. Building 117, the primer house, remains intact. Facilities 376 and 377 were used by the Navy as part of dredging operations and are located on the western part of the island approximately 1800 feet north of Building 102.

The Clouter Island property investigated here covers approximately 13.8 acres and is the site of three AOCs; AOC 693, the Fuse and Primer House, AOC 694, the Former Naval Ammunition Depot, and AOC 695, the Electric Locomotive Shed. Land cover within the drainage basins consists of approximately 99% unpaved surfaces and 1% buildings. The combined drainage basin is bordered to the west and south by the Cooper River, to the east by the DMA, and to the north by an unpaved area. Storm water runoff within the drainage basin runs off west and south to the Cooper River.

Figure 4-40 illustrates the area encompassing the southwestern portion of Clouter Island and associated RCRA sites, and storm water drainage features.

4.40.1 Potential Source Areas

A review of the listing of sites in Appendix A of the Part B permit indicates there are two SWMUs/AOCs that are partly or completely within the boundary of Clouter Island. Three sites are listed in Table 4.40.1 along with current status. These potential source areas are AOCs 693, 694, and 695.

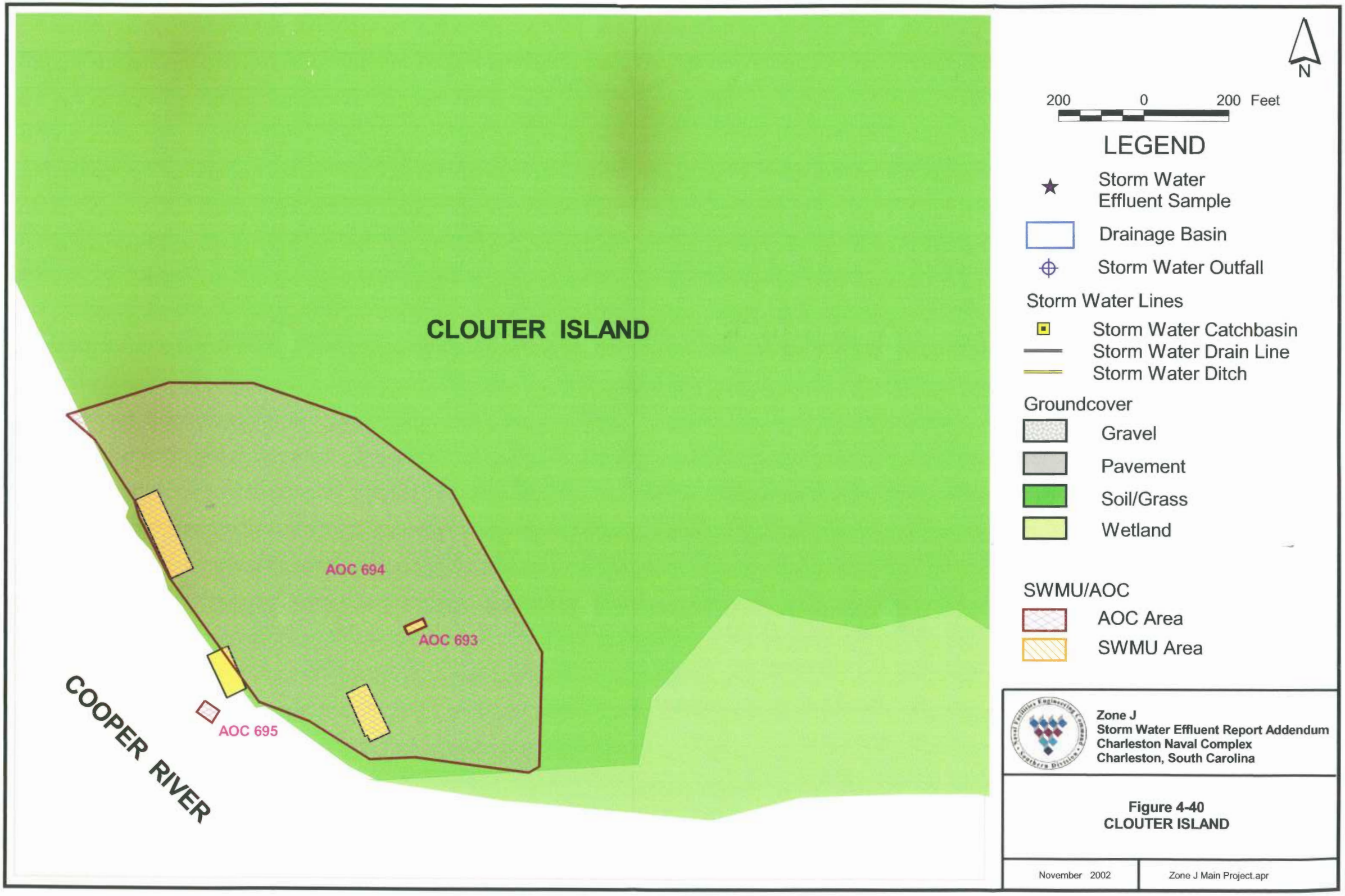

CLOUTER ISLAND
AOC 694
AOC 693
AOC 695
COOPER RIVER
N
200 0 200 Feet
LEGEND
Storm Water Effluent Sample
Drainage Basin
Storm Water Outfall
Storm Water Lines
Storm Water Catchbasin
Storm Water Drain Line
Storm Water Ditch
Groundcover
Gravel
Pavement
Soil/Grass
Wetland
SWMU/AOC
AOC Area
SWMU Area
Zone J
Storm Water Effluent Report Addendum
Charleston Naval Complex
Charleston, South Carolina
Figure 4-40
CLOUTER ISLAND
November 2002
Zone J Main Project.apr

Table 4.40.1
Clouter Island SWMUs/AOCs
Charleston Naval Complex, Charleston, South Carolina

SWMU/AOC	Site Name	RCRA Permit Status
AOC 693	Fuse and Primer House	Draft RFI Report; RFI Report Addendum
AOC 694	Naval Ammunition Depot	Draft RFI Report; RFI Report Addendum
AOC 695	Electric Locomotive Shed	Draft RFI Report; RFI Report Addendum

4.40.1.1 AOCs 693/694

Site Description and History

AOC 693 consists of Building 117, a two-room wood structure used for fuse and primer storage, which operated from 1930 to 1939. No visual evidence of past operations is present in the building.

AOC 694, the former Naval Ammunition Depot in operation from the 1920s to the 1940s, consists of an area surrounding former Building 117. The exact location and dimensions of this former explosives storage area are not known. Remnants of three other structures also remain within the former depot. The northernmost structure is the foundation of Building 106, the Fixed Ammo Storehouse. The foundation of Building 102, the Shell House, is approximately 200 feet south of Building 106. The former site of Building 103, the Magazine, is located between the remains of Buildings 102 and 117. Several buried ordnance shells were discovered on the island and removed in 1985. Dredge materials may have been deposited in this area after discontinuing use as an ammunition depot.

AOCs 693 and 694 were investigated as a combined AOC due to proximity and similar histories. Ordnance, metals, paints, oils, and solvents were identified as materials of concern in the final RFI work plan.

Previous Investigations

A summary of investigative activities performed at AOC 693/694 is presented in Table 4.40.2. Detailed discussions and results are presented in the *Final Zone K RFI* (EnSafe, 1999) and the *Clouter Island Report Addendum* (EnSafe, 2002).

Table 4.40.2
Summary of AOC 693/694 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1997-1998	Site investigation of soil and groundwater.	
		Round 1 **Soil:** 25 surface soil (0 to 1 foot) borings and 9 subsurface soil (3 to 5 feet) borings (693SB001-693SB004, 694SB001- 694SB019): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, Explosives, Hexavalent Chromium, Dioxins, and organotins	***Round 1*** **Groundwater:** 6 shallow groundwater samples (694002-694007): VOCs, SVOCs, pesticides, PCBs, metals, cyanide, organotins, chloride, sulfate and TDS. ***Rounds 2 through 4*** 6 shallow groundwater samples (694002-694007): VOCs, SVOCs, metals, dioxins, and cyanide
RFI (EnSafe)	1999	***Round 5*** **Soil:** 4 surface soil (0 to 1 foot) borings and 4 subsurface soil (3 to 5 feet) borings 694SB024- 694SB027): metals and Dioxins	***Round 5*** **Groundwater:** 3 shallow groundwater samples (694005-694007): Dioxins, metals, TSS
		Round 6 **Soil:** 23 surface soil (0 to 1 foot) borings and 14 subsurface soil (3 to 5 feet) borings (694SB028-694SB052): VOC, SVOC, pesticides, PCBs, metals, explosives	***Round 6*** **Groundwater:** 6 shallow groundwater samples (695008, 694009, 694GW011, 694012-694014): VOCs, SVOCs, metals
		Round 7 **Soil:** 8 surface soil (0 to 1 foot) borings and 8 subsurface soil (3 to 5 feet) borings (694SB05S, 694SB05T, 694SB12S, 694SB12T, 694SB13S, 694SB13T, 694SB14S, 694SB14T, 694SB18S, and 694SB18T): SPLP-TOC, TOC, SPLP-metals, metals	
RFI (EnSafe)	2000	***Round 7*** No Soil Samples Collected.	***Round 7*** **Groundwater:** Dioxins, metals, TSS, 3 shallow groundwater (7 to 8 feet deep) samples 694005, 694006, and 694007 were collected.

Table 4.40.2
Summary of AOC 693/694 Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
			Round 7 **Groundwater:** VOCs, SVOCs, metals 6 shallow groundwater (7 to 8 feet deep) samples 695008, 694009, 694011, 694012, 694013, and 694014 were collected.
RFI (EnSafe)	2002	***Rounds 8 and 9*** **Soil:** 14 surface soil (0 to 1 foot) and 14 subsurface soil (3 to 5 feet) borings 694SB41A, 694SB053-694SB065): Lead	***Rounds 8 and 9*** **Groundwater:** 4 shallow groundwater samples (694009, 694013, 694015, and 694016): metals

Nature and Extent of Contaminants

Approximately 69 sample locations associated with AOCs 693/694 were evaluated for the presence of contaminants between 1997 and 2002. All sample locations are within the boundaries of Clouter Island. Surface, subsurface, and groundwater samples were collected and analyzed for various constituents in order to delineate the nature and extent of potential contamination attributable to site activities.

4.40.1.2 AOC 695

Site Description and History

AOC 695, the location of the former Locomotive Shed, is completely submerged beneath the Cooper River.

Previous Investigations

A summary of investigative activities performed at AOC 695 is presented in Table 4.40.3. Detailed discussions and results are presented in the *Final Zone K RFI Report*.

Table 4.40.3
Summary of AOC 695Investigations
Charleston Naval Complex, Charleston, South Carolina

Activity	Date	Description/Samples/Locations	
RFI (EnSafe)	1997	Site investigation of sediments	
		Round 1 **Soil:** 2 sediment samples collected (695M0001-695M0002): VOCs, SVOCs, metals, pesticides, PCBs, cyanide, Hexavalent Chromium, organotins	No groundwater samples collected

Nature and Extent of Contaminants

Two sample locations associated with AOC 695 were evaluated in 1997 for the presence of contaminants. All sample locations are south of the marked location for the AOC.

4.40.2 Storm Water Effluent Evaluation

Storm water effluent samples were not collected because there are no storm water control structures on Clouter Island.

4.40.3 Pathway Evaluation

Evaluation of the contaminant migration pathway scenarios described in Section 2.1.2 of the *Storm Water Effluent Evaluation Report* and determination of the applicability of each scenario to Clouter Island will be conducted as part of the SLERA process for the Cooper River evaluation for Zone J.

4.40.4 Summary of Potential COPCs

Potential COPCs for Clouter Island will be determined during the COPC Refinement process.