1983/31.  FORTRAN programs for performing gravity reduction (Revision 1)

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*Abstract*

The main program calculates observed Bouguer anomalies from station position, gravity difference, and terrain correction data. Options are available for most forms of data specification.  A short program performs conversions between the kiloyard and metric grids.

INTRODUCTION

The programs were adapted for use on the Department of Mines Perkin-Elmer 8/32 computer from ALGOL versions running on the ELLIOTT 503 and Burroughs B6700 computers at the University of Tasmania.  The FORTRAN 77 versions described here may be easily transferred to other computers.

THE PROGRAMS

*U191V6 (Appendix 1)*

This program implements the gravity reduction method outlined in Leaman (1981) and uses the old equation for normal gravity.  By selecting the appropriate control data, station positions may be in metric grid co-ordinates or latitude and longitude, heights may be in feet or metres, and the observed gravity may be in milligals or meter scale divisions. The data is terminated by a station number less than -9000.0.  Input is on logical unit 4 and output is on logical unit 6.

Input data is:

PA1, PA3, PA4, PA5 - format (I4, F12.4, F10.2, A8)
- PA1 is the survey number and has the form (for the Department of Mines) XX51 where XX is the year of the survey
- PA3 is the number of the reference station
- PA4 is the absolute gravity value at the reference station (milligals)
- PA5 is the date of reference station establishment *e.g.* 041181

PA6, SCONST, PA8 - format (A4, F10.5, A8)
- PA6 is the meter number *e.g.* W273, S308
- SCONST is the meter scale constant in milligals per scale division
- PA8 is the meter calibration date *e.g.* 030180

PA9, PA12, PA14, PA16, PA17 - format (5I1)
- PA9 = 1 - input elevations in metres
      = 0 - input elevations in feet
- PA12 = 1 - input units milligals
       = 0 - input units scale divisions
- PA14 = 1 - input in metric grid co-ordinates
       = 0 - input in latitude and longitude
- PA16 = 1 - output elevations in metres
       = 0 - output elevations in feet
- PA17 = 1 - output in grid co-ordinates
       = 0 - output in latitude and longitude

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RHO, HTCOR              - format (F6.2, F9.2)
                        - RHO is the Bouguer density (t/m³)
                        - HTCOR is any elevation datum change that might
                            be required

TITLE                   - format (18A4)
                        - the survey title
```

For each station:

(i)    input in grid co-ordinates:

```
A1, EAST, NORTH, ELEV, GOBS, ABC, CORR - format (F9.4, 2F10.3, F8.2,
                      F10.2, 2A4, A2, F7.2)
                        - A1 is the station number in the form 8051.1234
                            or .1234
                        - EAST is the east co-ordinate of the station (in
                            metres)
                        - NORTH is the north co-ordinate of the station
                            (in metres)
                        - ELEV is the station elevation
                        - GOBS is the observed gravity difference
                        - ABC is an alphanumeric string
                        - CORR is any correction - e.g. terrain correction
```

(ii)   input in latitude and longitude:

```
A1, LATD, LATM, LATS, LOND, LONM, LONS, ELEV, GOBS, ABC, CORR
                        - format (F9.4, I3, 2F6.0, I4, 2F6.0, F8.2,
                            F10.2, 2A4, A2, F7.2)
                        - A1 is the station number in the form 8051.1234
                            or .1234
                        - LATD is the latitude degrees (integer)
                        - LATM is the latitude minutes (real or integer)
                        - LATS is the latitude seconds (may be zero if
                            LATM is real)
                        - LOND is the longitude degrees (integer)
                        - LONM is the longitude minutes (real or integer)
                        - LONS is the longitude seconds (may be zero if
                            LONM is real)
                        - ELEV is the station elevation
                        - GOBS is the observed gravity difference
                        - ABC is an alphanumeric string
                        - CORR is any correction - e.g. terrain correction
```

After the last station of a data set -99999. should appear instead
of the station number.

Appendices 2, 3 and 4 show sample inputs and outputs.

*KYD2KM (Appendix 5)*

This program converts co-ordinates from the kiloyard grid to the
metric grid. Data is prepared in the format used for U191V6 with co-
ordinates in yards instead of metres. The program converts the co-ordinates
and produces an output suitable for U191V6. Input is on logical unit 4 and
output is on logical unit 6.

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REFERENCE

LEAMAN, D.E.   1981.   Gravity survey and reduction techniques.   *Geophys.*
    *Spec.Rep.Dep.Mines Tasm.*   9.

[13 July 1983]

APPENDIX 1

Program U191V6

```
$TITL  U191V6.FTN  -   GRAVITY REDUCTION PROGRAM
C USED TO CALCULATE GRAVITY REDUCTIONS GIVEN ELEVATIONS,
C COORDS(LAT & LONG OR METRIC GRID),BASE VALUES,METER READINGS
C OR OBSERVED GRAVITIES AND TERRAIN CORRECTIONS.
C RICHARDSON,1981
C
       REAL PA6
       INTEGER*2 PA1,PA17,PA9,PA10,PA12,PA13,PA14,PA15,NA,
     . PA16,NL,PA91,PA141,PA121,PA161,PA171
       DOUBLE PRECISION PA4,SCONST,PA5,PA3,PA8,RHO,HTCOR
       REAL TITLE(18)
       DOUBLE PRECISION A1,A2GRID,A5GRID,A2,A3,A4,A5,A6,A7,CORR,A2T,
     . A3T,A4T,ELEV,GOBS,GTHEO,FAA,BA,GBASE
       INTEGER*2 N,IA2,IA3,IA5,IA6
       REAL ABC(3),AR(6)
C
C THE PROGRAM BODY
       READ(4,100) PA1,PA3,PA4,PA5
   100 FORMAT(I4,F12.4,F10.2,A8)
C    PA1=SURVEY NUMBER
C    PA3=REFERENCE STATION NUMBER
C    PA4=REFERENCE STATION VALUE(MGALS)
C    PA5=DECIMAL DATE OF BASE STATION ESTABLISHMENT
       READ(4,101) PA6,SCONST,PA8
   101 FORMAT(A4,F10.5,A8)
C    PA6=METER NUMBER
C    SCONST=SCALE CONSTANT
C    PA8=METER CALIBRATION DATE
       READ(4,102) PA9,PA12,PA14,PA16,PA17
   102 FORMAT(5I1)
       PA10=1-PA9
       PA13=1-PA12
C    PA9  =1 INPUT ELEVATION METRES
C         =0 INPUT ELEVATION FEET
C    PA12 =1 INPUT MGALS
C         =0 INPUT SCALE DIVISIONS RELATIVE TO BASE STATION
C    PA14 =1 INPUT GRID COORDS
C         =0 INPUT LAT/LONG
C    PA16 =1 OUTPUT IN METRES
C         =0 OUTPUT IN FEET
C    PA17 =1 OUTPUT IN GRID COORDS
C         =0 OUTPUT IN LAT/LONG
       READ(4,104) RHO,HTCOR
   104 FORMAT(F6.2,F9.2)
C    RHO = BOUGUER DENSITY(T/M*M*M)
C    HTCOR = AN ELEVATION DATUM CHANGE
       READ(4,105) TITLE
   105 FORMAT(18A4)
C ADD SIMPLE VARIABLES TO COPE WITH 1-PA9 ETC. IN PRINT STATEMENT
       PA91=1-PA9
       PA141=1-PA14
       PA121=1-PA12
       PA161=1-PA16
       PA171=1-PA17
       WRITE(6,201) PA1,PA3,PA4,PA5,PA6,SCONST,PA8,PA9,PA91,
     . PA14,PA141,PA12,PA121,RHO,PA16,PA161,HTCOR,
     . PA17,PA171,TITLE
   201 FORMAT(30X,'SURVEY'/34X,'NUMBER',15X,I7//30X,'DATUM'/
```

```
      .  34X, 'REFERENCE STATION', 4X, F12. 4/34X, 'VALUE (IN MGALS)',
      .  7X, F10. 2/34X, 'DATE (DECIMAL)', 8X, A8//30X, 'METER'/34X,
      .  'NUMBER', 18X, A4/34X, 'SCALE CONSTANT', 5X, F12. 5/34X,
      .  'CALIBRATION DATE', 6X, A8//30X, 'FIELD DATA'/34X, 'ELEVATION'/
      .  38X, 'IN METRES', 9X, I3/38X, 'IN FEET', 11X, I3/34X, 'STATION',
      .  ' POSITIONS'/38X, 'IN GRID COORDS', 4X, I3/38X, 'IN LAT/LONG',
      .  7X, I3/34X, 'OBSERVED GRAVITY'/38X, 'IN MGALS', 10X, I3/38X,
      .  'IN SCALE DIVS', 5X, I3//30X, 'OUTPUT DATA'/34X, 'BOUGUER',
      .  ' DENSITY', 5X, F8. 2/
      .  34X, 'ELEVATION'/38X, 'IN METRES', 9X, I3/38X, 'IN FEET', 11X,
      .  I3/34X, 'ELEVATION DATUM CHANGE', F12. 2/34X, 'STATION ',
      .  'POSITIONS'/38X, 'IN GRID COORDS', 4X, I3/38X, 'IN LAT/LONG',
      .  7X, I3///20X, 18A4)
         N=0
         PA15=0
         GBASE=PA4*1. 0D-03
         CALL HEADNG(PA17)
   51 CONTINUE
         IF (PA14 .EQ.  1) READ(4,106) A1, A2GRID, A5GRID, ELEV, GOBS, ABC, CORR
  106 FORMAT(F9. 4, 2F10. 1, F8. 2, F10. 2, 2A4, A2, F7. 2)
C     A1 = STATION NUMBER
C     A2GRID = EAST GRID COORD
C     A5GRID = NORTH GRID COORD
C     ELEV = ELEVATION
C     GOBS = OBSERVED GRAVITY
C     ABC = TITLE OF LESS THAN 10 CHARACTERS
C     CORR = CORRECTION TO OBSERVED GRAVITY
         IF (PA14 .EQ.  0) READ(4,107) A1, A2T, A3T, A4T, A5, A6, A7, ELEV,
      .  GOBS, ABC, CORR
  107 FORMAT(F9. 4, I3, 2F6. 0, I4, 2F6. 0, F8. 2, F10. 2, 2A4, A2, F7. 2)
C     A1 = STATION NUMBER
C     A2 = LATDEG
C     A3 = LAT MIN - MAY BE REAL
C     A4 = LAT SEC
C     A5 = LONG DEG
C     A6 = LONG MIN -  MAY BE REAL
C     A7 = LONG SEC
C     ELEV = ELEVATION
C     GOBS = OBSERVED GRAVITY
C     ABC = TITLE
C     CORR = CORRECTION TO OBSERVED GRAVITY
         IF (A1 .LT.  -9000. 0D00) GOTO 71
         IF (A1 .LT.  1. 0D00) A1=A1+PA1
C IF THE STATION NUMBER IS LESS THAN NUMBER THEN ADD 1 TO THE STATION
C NUMBER
C IF THE STATION NUMBER IS LESS THAN 1 ADD THE SURVEY NUMBER
         PA15=PA15+1
C INCREMENT THE COUNTER FO THE NUMBER OF STATIONS
         GOBS=GOBS*(DBLE(FLOAT(PA12))+DBLE(FLOAT(PA13))*SCONST)
C CONVERT FROM SCALE DIVISIONS TO MGALS
         ELEV=ELEV+HTCOR
C APPLY CHANGE IN ELEVATION DATUM
         ELEV=ELEV*(DBLE(FLOAT(PA9))+0. 3047997D00*DBLE(FLOAT(PA10)))
C CONVERT FEET TO METRES
         IF (PA14 .EQ.  0) GOTO 10
C IF PA14=1 HAVE INPUT IN GRID COORDS
         CALL GEOGRF(A2GRID, A5GRID, AR)
         A2T=AR(1)
         A3T=AR(2)
         A4T=AR(3)
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      A5=AR(4)
      A6=AR(5)
      A7=AR(6)
      GOTO 11
C
C IF IN DEGREES CONVERT DECIMAL MINUTES TO MINUTES AND SECONDS
   10 CONTINUE
      CALL CONVRT(A3T,A4T)
      CALL CONVRT(A6,A7)
   11 CONTINUE
      A2=A2T
      A3=A3T
      A4=A4T
      GOBS=(GOBS+CORR)*1.0D-03+GBASE
      A2=(A2+A3/60.0D00+A4/3600.0D00)*0.0174532925D+00
      A3=DSIN(A2)
      GTHEO=978.0490D00+5.172314332D00*A3*A3-0.0057704891D00*
     .  4.0D00*A3*A3*(1.0D00-A3*A3)
      FAA=0.000308772D00*ELEV*(1.0D00-0.001422D00*A3*A3)
     .      +7.2D-11*ELEV*ELEV+GOBS-GTHEO
      BA=-6.2831853D00*RHO*6.67D-06*ELEV
      BA=FAA+BA
      IF (PA16 .EQ. 0) ELEV=ELEV*3.2808399D00
C ELEVATION BACK TO FEET IF NEEDED
      GOBS=GOBS-CORR*1.0D-03
      FAA=FAA-CORR*1.0D-03
      BA=BA*1.0D03
      IA2=A2T
      IA3=A3T
      IA5=A5
      IA6=A6
      IF (PA17 .EQ. 0) GOTO 20
      IF (PA14 .EQ. 1) GOTO 19
C IF OUTPUT WANTED IN LAT/LONG OR INPUT ALREADY IN GRID COORDS
C BYPASS
      ALATD=A2T
      ALATM=A3T
      ALATS=A4T
      ALOND=A5
      ALONM=A6
      ALONS=A7
      CALL GEOUTM(ALATD,ALATM,ALATS,ALOND,ALONM,ALONS,A2GRID,A5GRID)
C CONVERT TO KM GRID
      A5GRID=A5GRID-5000000.0D00
C REMOVE THE LEADING 5E6
   19 IF (PA17 .EQ. 1) WRITE(6,202) A1,A2GRID,A5GRID,ELEV,GOBS,
     . GTHEO,CORR,BA,ABC
  202 FORMAT(F12.4,2F10.0,F10.2,2F11.5,2F8.2,4X,2A4,A2)
   20 IF (PA17 .EQ. 0) WRITE(6,203) A1,IA2,IA3,A4T,IA5,IA6,A7,
     . ELEV,GOBS,GTHEO,CORR,BA,ABC
  203 FORMAT(F12.4,2I4,F6.1,I5,I4,F6.1,F10.2,2F11.5,2F8.2,4X,2A4,A2)
      N=N+1
      IF (N .LT. 55) GOTO 71
      CALL HEADNG(PA17)
      N=0
   71 CONTINUE
      IF (A1 .GT. 0.0) GOTO 51
      WRITE(6,204) PA15
  204 FORMAT(/I5)
      STOP
```

```
      END
      SUBROUTINE DECDEG(ANGLE, IDEG, MIN, SEC)
      DOUBLE PRECISION ANGLE, SEC
      INTEGER*2 IDEG, MIN
      DOUBLE PRECISION DEGI, RMIN
      IDEG=IFIX(SNGL(ANGLE))
      DEGI=IDEG
      ANGLE=60. 0D00*(ANGLE-DEGI)
      MIN=IFIX(SNGL(ANGLE))
      RMIN=MIN
      SEC=60. 0D00*(ANGLE-RMIN)
      RETURN
      END
      SUBROUTINE GEOGRF(EAST, NORTH, ANSWER)
      DOUBLE PRECISION NORTH, EAST
      REAL ANSWER(6)
      DOUBLE PRECISION TMD1, ORTH, DEG, TMD2, CON, Q1, DOG, SIND, COSD,
     . TAND, TANSQ, SINSEC, C, D, DTAN, R, P, PCUBE, POR, PFIVE, P1, P2, P3, P4,
     . P5, GLAT, TEMPL, DLONG, DC, SLO, SLA
      DOUBLE PRECISION VAL(16), Q(5)
      INTEGER*2 I, IDLA, MLA, IDLO, MLO
C CONVERTS AMG GRID COORDS (IN METRES) TO LATS AND LONGS
C INPUT OF NORTH COORDINATE EXCLUDES LEADING 5 FOR USE IN TASMANIA
C E. G.  5326446. 014 BECOMES 326446. 014
      VAL(1)=9. 033D-06
      VAL(2)=1. 1113334878D05
      VAL(3)=3. 4906585D-02
      VAL(4)=6. 981317D-02
      VAL(5)=1. 04719755D-01
      VAL(6)=9. 008D-06
      VAL(7)=1. 745329252D-02
      VAL(8)=0. 66945418546D-02
      VAL(9)=1. 99840032D-08
      VAL(10)=23. 96162303D-20
      VAL(11)=5. 99280287940-14
      VAL(12)=119. 76019192D-26
      VAL(13)=2. 99640143970-14
      VAL(14)=14. 970023989D-26
      VAL(15)=6. 3354611409D06
      VAL(16)=1. 60389546D04
C
      ORTH=NORTH+5. 0D06
C ADD THE LEADING 5 TO THE NORTH COORDINATE
      TMD1=1. 0D07-ORTH
      DEG=VAL(1)*TMD1
C
      DO 10 I=1, 10
      TMD2=VAL(2)*DEG-VAL(16)*DSIN(VAL(3)*DEG)+
     . 16. 83310D00*DSIN(VAL(4)*DEG)-0. 0218D00*DSIN(VAL(5)*DEG)
      CON=TMD1-0. 9996D00*TMD2
      IF (DABS(CON) . LT. 1. 0D-03) GOTO 14
      DEG=DEG+VAL(6)*CON
   10 CONTINUE
      GOTO 16
C
   14 CONTINUE
      Q1=(EAST-500000. 0D00)*1. 0D-06
      Q(1)=Q1
      DO 11 I=2, 5
      Q(I)=Q(I-1)*Q1
```

```
  11 CONTINUE
     DOG=VAL(7)*DEG
     SIND=DSIN(DOG)
     COSD=DCOS(DOG)
     TAND=SIND/COSD
     TANSQ=TAND*TAND
     SINSEC=0.48481368111D-05
     C=1.0D00-VAL(8)*SIND*SIND
     D=0.27777777778D01
     DTAN=D*TAND
     R=VAL(15)/C**1.5
     P=637816.0D01/C**0.5
     PCUBE=P**3
     POR=P/R
     PFIVE=PCUBE*P*P
     P1=DTAN/(VAL(9)*R*P*SINSEC)
     P2=DTAN*(5.0D00+3.0D00*TANSQ)/(VAL(10)*R*PCUBE*SINSEC)
     P3=D/(P*COSD*SINSEC*.9996D-02)
     P4=D*(POR+2.0D00*TANSQ)/(VAL(11)*PCUBE*SINSEC*COSD)
     P5=D*(5.0D00+TANSQ*(28.0D00+24.0D00*TANSQ))/(VAL(12)*
    .      COSD*PFIVE*SINSEC)
     GLAT=DEG-P1*Q(2)+P2*Q(4)
     TEMPL=P3*Q1-P4*Q(3)+P5*Q(5)
     DLONG=TEMPL+7.0D00
     CALL DECDEG(DLONG,IDLO,MLO,SLO)
     IDLO=IDLO+140
     CALL DECDEG(GLAT,IDLA,MLA,SLA)
     GOTO 18
  16 CONTINUE
     WRITE(5,100)
 100 FORMAT(' **************** GEOGRAPHICAL ERROR ****************')
     STOP 9998
  18 CONTINUE
     ANSWER(1)=IDLA
     ANSWER(2)=MLA
     ANSWER(3)=SLA
     ANSWER(4)=IDLO
     ANSWER(5)=MLO
     ANSWER(6)=SLO
C STORE LAT AND LONG READY TO RETURN
     RETURN
     END
     SUBROUTINE CONVRT(A,B)
     DOUBLE PRECISION A,B
     INTEGER*2 I
     A=A+(B/60.0D00)
     I=IFIX(SNGL(A))
     B=(A-DBLE(FLOAT(I)))*60.0D00
     A=I
     RETURN
     END
     SUBROUTINE HEADNG(PA17)
     INTEGER*2 PA17
     WRITE(6,100)
 100 FORMAT(1H1)
     IF (PA17 .EQ. 0) WRITE(6,102)
 102 FORMAT('   ST NUMBER     LATITUDE       LONGITUDE',
    .  6X,'HEIGHT  OBS GRAV    THEO GRAV    CORRN',4X,'BA',7X,
    .  'COMMENT'/)
     IF (PA17 .EQ. 1) WRITE(6,113)
```

```
113 FORMAT(3X, 'ST NUMBER        EAST', 5X, 'NORTH', 5X,
    . 'HEIGHT   OBS GRAV    THEO GRAV', 3X, 'CORRN', 4X, 'BA',
    . 7X, 'COMMENT'/)
    RETURN
    END
$TITLE GEOUTM GRID CONVERSION
    SUBROUTINE GEOUTM(ALATD, ALATM, ALATS, ALOND, ALONM, ALONS, EAST, YNORTH)
C BASED ON THE TAS LANDS DEPT PROGRAM UTM
C THE EQUATIONS USED ARE FROM TM PROJECTION TABLES 1944.
C THE ORIGINAL FORMULAE AGREE WITH REDFEARNS FOR THE 1ST. AND
C 2ND. TERMS BUT DIFFER IN THE 3RD. TERM. HOWEVER TO IMPROVE
C ACCURACY THE FORMULA FOR NORTHING HAS BEEN CHANGED TO AGREE
C WITH REDFEARNS IN THE 3RD. TERM (Q3)
C CONVERTS FROM GEOGRAPHIC TO UTM COORDINATES
C INPUT IS LATDEG, LATMIN, LATSEC
C         LONDEG, LONMIN, LONSEC
C OUTPUT IS EAST COORDINATE, NORTH COORDINATE (DOUBLE PRECISION, METRES)
    DOUBLE PRECISION DEG, S, EAST, YNORTH, SIND, COSD, TAND, C, R, P, PC, PCC,
    . P1, P2, Q1, Q2, Q3, Q4, Q5, Q6
    DEG=DBLE(ALATD)+DBLE(ALATM)/60. 0D00+DBLE(ALATS)/3600. 0D00
    S=111133. 34878D00*DEG-16038. 9546D00*DSIN(0. 034906585D00*DEG)+
    . 16. 9331D00*DSIN(0. 0698132D00*DEG)-0. 0218D00*DSIN(0. 10472D00*DEG)
    DEG=0. 01745329252D00*DEG
    SIND=DSIN(DEG)
    COSD=DCOS(DEG)
    TAND=(SIND/COSD)**2
    C=1. 0D00-0. 6694541855D-2*SIND**2
    R=6335461. 141D00/C**1. 5
    P=6378160. 0D00/DSQRT(C)
    PC=P*COSD
    PCC=PC*COSD**2
    P1=(DBLE(ALONS)+DBLE(ALONM)*60. 0D00+DBLE(ALOND)*3600. 0D00
    .     -529200. 0D00)*1. D-4
    P2=P1**2
    Q1=1. D+7-0. 9996D00*S
    Q2=PC*SIND*0. 117475144D-2
    Q3=PCC*SIND*(4. 0D00*(P/R)**2+P/R-TAND)*0. 230099D-6
    Q4=PC*0. 48461975563D-1
    Q5=PCC*(P/R-TAND)*0. 18984519D-4
    Q6=PCC*COSD*COSD*(5. 0D00-TAND*(18. 0D00-TAND))*0. 22311D-8
    EAST=500000. 0D00+P1*(Q4+P2*(Q5+P2*Q6))
    YNORTH=Q1-P2*(Q2+P2*Q3)
    RETURN
    END
```

# APPENDIX 2

## Sample data, latitude input

```
8051     8051.9900 980169.78  181280
W913     0.0940  131278
10010
  2.67
QUE RIVER MINE AREA 1980
    .6001 41    35   57.4 145    41   47.5   695.4    10.53         1.47
    .6002 41 35.93       145 41.73       683.7    28.08         1.48
  -99999.
```

| SURVEY | | |
|---|---|---|
| NUMBER | | 8051 |

| DATUM | | |
|---|---|---|
| REFERENCE STATION | | 8051.9900 |
| VALUE (IN MGALS) | | 980169.78 |
| DATE (DECIMAL) | | 181280 |

| METER | | |
|---|---|---|
| NUMBER | | W913 |
| SCALE CONSTANT | | 0.09400 |
| CALIBRATION DATE | | 131278 |

| FIELD DATA | | |
|---|---|---|
| ELEVATION | | |
| IN METRES | | 1 |
| IN FEET | | 0 |
| STATION POSITIONS | | |
| IN GRID COORDS | | 0 |
| IN LAT/LONG | | 1 |
| OBSERVED GRAVITY | | |
| IN MGALS | | 0 |
| IN SCALE DIVS | | 1 |

| OUTPUT DATA | | |
|---|---|---|
| BOUGUER DENSITY | | 2.67 |
| ELEVATION | | |
| IN METRES | | 1 |
| IN FEET | | 0 |
| ELEVATION DATUM CHANGE | | 0.00 |
| STATION POSITIONS | | |
| IN GRID COORDS | | 0 |
| IN LAT/LONG | | 1 |

QUE RIVER MINE AREA 1980

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| ST NUMBER | LATITUDE | | | LONGITUDE | | | HEIGHT | OBS GRAV | THEO GRAV | CORRN | BA | COMMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8051.6001 | 41 | 35 | 57.4 | 145 | 41 | 47.5 | 695.40 | 980.17077 | 980.32319 | 1.47 | -14.14 | |
| 8051.6002 | 41 | 35 | 55.8 | 145 | 41 | 43.8 | 683.70 | 980.17242 | 980.32315 | 1.48 | -14.75 | |

2

APPENDIX 3

Sample data, AMG input and output


```
8051    8051.9900 980169.78   181280
W913     0.0940   131278
10110
  2.67  0.0
QUE RIVER MINE AREA GRAVITY SURVEY    DECEMBER 1980
     .6001   391373.   393878.   695.4    10.53              1.47
     .6002   391283.   393926.   683.7    28.08              1.48
     .6003   391396.   393869.   698.5     7.10              1.44
     .6004   391419.   393860.   699.2     3.32              1.44
     .6005   391442.   393850.   700.6    -0.96              2.00
-99999.
```


SURVEY
    NUMBER                    8051

DATUM
    REFERENCE STATION        8051.9900
    VALUE (IN MGALS)         980169.78
    DATE (DECIMAL)           181280

METER
    NUMBER                    W913
    SCALE CONSTANT           0.09400
    CALIBRATION DATE         131278

FIELD DATA
    ELEVATION
        IN METRES           1
        IN FEET             0
    STATION POSITIONS
        IN GRID COORDS      1
        IN LAT/LONG         0
    OBSERVED GRAVITY
        IN MGALS            0
        IN SCALE DIVS       1

OUTPUT DATA
    BOUGUER DENSITY         2.67
    ELEVATION
        IN METRES           1
        IN FEET             0
    ELEVATION DATUM CHANGE      0.00
    STATION POSITIONS
        IN GRID COORDS      1
        IN LAT/LONG         0


QUE RIVER MINE AREA GRAVITY SURVEY    DECEMBER 1980

| ST NUMBER | EAST | NORTH | HEIGHT | OBS GRAV | THEO GRAV | CORRN | BA | COMMENT |
|---|---|---|---|---|---|---|---|---|
| 8051. 6001 | 391373. | 393878. | 695. 40 | 980. 17077 | 980. 32319 | 1. 47 | -14. 14 | |
| 8051. 6002 | 391283. | 393926. | 683. 70 | 980. 17242 | 980. 32315 | 1. 48 | -14. 75 | |
| 8051. 6003 | 391396. | 393869. | 698. 50 | 980. 17045 | 980. 32320 | 1. 44 | -13. 89 | |
| 8051. 6004 | 391419. | 393860. | 699. 20 | 980. 17009 | 980. 32321 | 1. 44 | -14. 12 | |
| 8051. 6005 | 391442. | 393850. | 700. 60 | 980. 16969 | 980. 32321 | 2. 00 | -13. 69 | |

5

APPENDIX 4

Sample data, AMG input, latitude and longitude output


```
805:L    8051.9900 980169.78  181280
W913     0.0940   131278
10110
   2.67  0.0
QUE RIVER MINE AREA GRAVITY SURVEY    DECEMBER 1980
     .6001    391373.    393878.    695.4     10.53          1.47
     .6002    391283.    393926.    683.7     28.08          1.48
     .6003    391396.    393869.    698.5      7.10          1.44
     .6004    391419.    393860.    699.2      3.32          1.44
     .6005    391442.    393850.    700.6     -0.96          2.00
-99999.
```

```
                         SURVEY
                              NUMBER                    8051

                         DATUM
                              REFERENCE STATION         8051.9900
                              VALUE (IN MGALS)          980169.78
                              DATE (DECIMAL)            181280

                         METER
                              NUMBER                    W913
                              SCALE CONSTANT        .   0.09400
                              CALIBRATION DATE          131278

                         FIELD DATA
                              ELEVATION
                                   IN METRES           1
                                   IN FEET             0
                              STATION POSITIONS
                                   IN GRID COORDS      1
                                   IN LAT/LONG         0
                              OBSERVED GRAVITY
                                   IN MGALS            0
                                   IN SCALE DIVS       1

                         OUTPUT DATA
                              BOUGUER DENSITY           2.67
                              ELEVATION
                                   IN METRES           1
                                   IN FEET             0
                              ELEVATION DATUM CHANGE          0.00
                              STATION POSITIONS
                                   IN GRID COORDS      0
                                   IN LAT/LONG         1
```

QUE RIVER MINE AREA GRAVITY SURVEY    DECEMBER 1980

| ST NUMBER | LATITUDE | | | LONGITUDE | | | HEIGHT | OBS GRAV | THEO GRAV | CORRN | BA | COMMENT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8051.6001 | 41 | 35 | 57.4 | 145 | 41 | 47.5 | 695.40 | 980.17077 | 980.32319 | 1.47 | -14.14 | |
| 8051.6002 | 41 | 35 | 55.8 | 145 | 41 | 43.6 | 683.70 | 980.17242 | 980.32315 | 1.48 | -14.75 | |
| 8051.6003 | 41 | 35 | 57.7 | 145 | 41 | 48.5 | 698.50 | 980.17045 | 980.32320 | 1.44 | -13.89 | |
| 8051.6004 | 41 | 35 | 58.0 | 145 | 41 | 49.5 | 699.20 | 980.17009 | 980.32321 | 1.44 | -14.12 | |
| 8051.6005 | 41 | 35 | 58.3 | 145 | 41 | 50.4 | 700.60 | 980.16969 | 980.32321 | 2.00 | -13.69 | |

5

31-15

APPENDIX 5

Program KYD2KM

```
$TITL  KYD2KM       CONVERT FROM KILOYARD GRID TO METRIC GRID
C COORDS. ARE IN FACT IN YARDS AND METRES.
C N. B.  THE METRIC CORRDINATES ARE LACKING THE LEADING 5
       DOUBLE PRECISION EAST, YNORTH, SNUM, OEAST, ONORTH, OESTSQ,
       . ONTHSQ, ODIFF
       DIMENSION A(20), B(10)
       EQUIVALENCE (A(1), B(1))
       DO 10 I=1, 5
       READ(4, 100) A
       WRITE(6, 100) A
   100 FORMAT(20A4)
    10 CONTINUE
C COPY CONTROL INFORMATION FROM HEAD OF FILE
    15 READ(4, 200) SNUM, OEAST, ONORTH, ELEV, GOBS, B, CORR
   200 FORMAT(F9. 4, 2F10. 1, F8. 2, F10. 2, 10A1, F7. 2)
       IF (SNUM . LT. -9000. 0D00) GOTO 40
C END OF DATA IF NEGATIVE
       OESTSQ=OEAST*OEAST
       ONTHSQ=ONORTH*ONORTH
       ODIFF=OESTSQ-ONTHSQ
       EAST=0. 914664D00*OEAST-0. 012023D00*ONORTH+5. 7D-11*OEAST
           *ONORTH-8. 4D-10*ODIFF+60756. 0D00
       YNORTH=0. 012023D00*OEAST+0. 914664D00*ONORTH-1. 678D-9*OEAST
           *ONORTH-2. 85D-11*ODIFF+4587325. 0D00
       YNORTH=YNORTH-5. 0D6
       WRITE(6, 200) SNUM, EAST, YNORTH, ELEV, GOBS, B, CORR
       GOTO 15
    40 CONTINUE
       WRITE(6, 201)
   201 FORMAT('-999999. ')
       STOP
       END
```