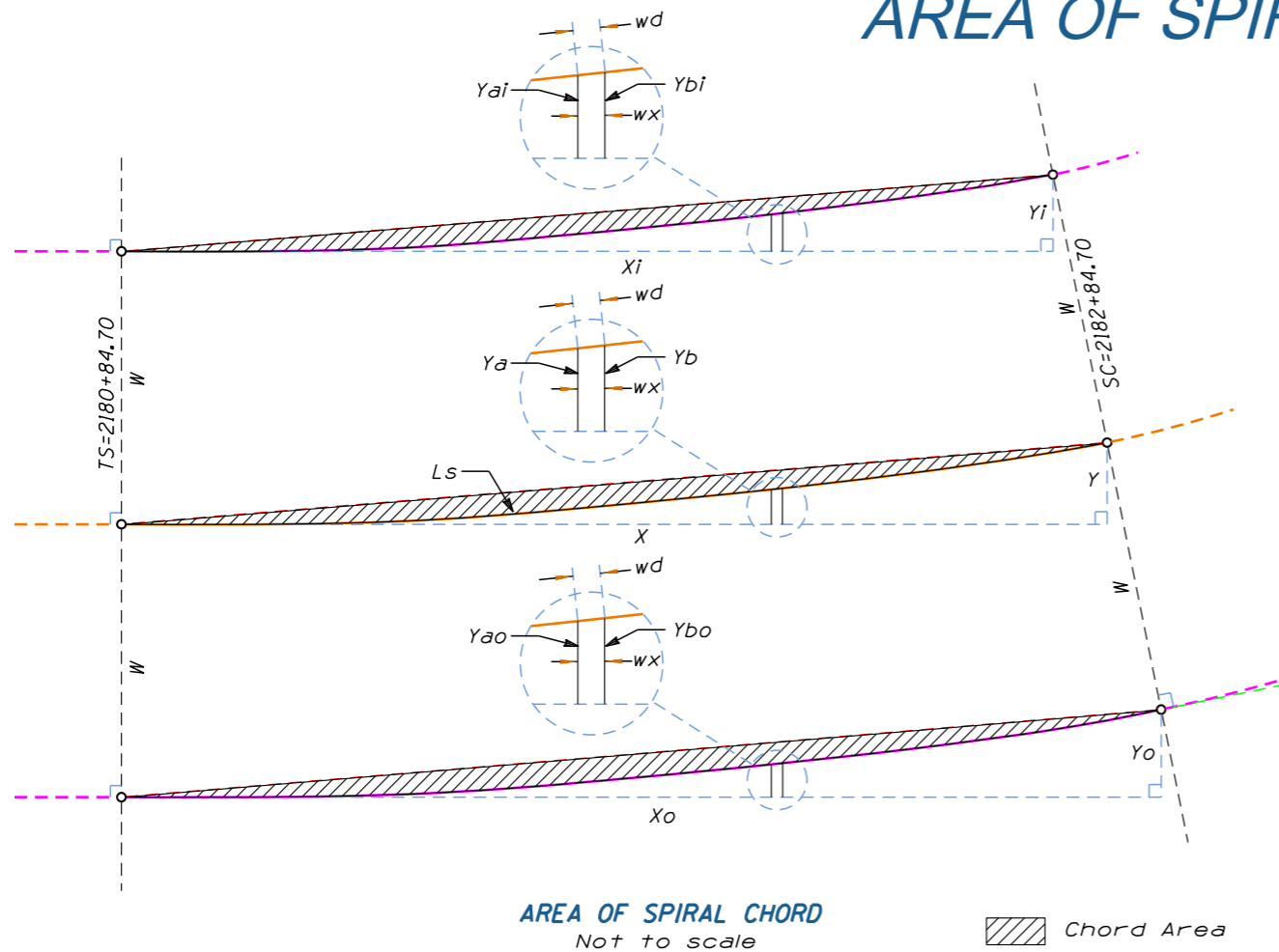# AREA OF SPIRAL CHORD

AREA OF SPIRAL CHORD
Not to scale

▨ Chord Area

FORMULAS

Given: a = 1, Ls = 200 (From SC-1); W = 100',
   Lsi = 196.50939, Xi = 196.48563, Yi = 2.26601 (From SC-2)
   wd = 1 (Interval distance) (Area precision is based upon wd)
   wx (Segment width)

$$\text{Chord Area} = (Xi * Yi / 2) - \sum_{Ls1=wd}^{Ls} (Yai + Ybi) / 2 * wx$$

Step 1:
Xi * Yi / 2 = 196.48563 * 2.26601 / 2 = <u>222.61920□</u>

Step 2
Summation: $\sum_{Ls1=wd}^{Ls} (Yai + Ybi) / 2 * wx$

Start Ls1 = wd:

$DefYa = a * Ls1^2 / 60000; \quad DefYb = a * (Ls1 + wd)^2 / 60000$

$Yai = (Ls1 - (0.00034 * a^2 * (Ls1 / 100)^5)) * Sin(DefYa) + ((Cos(DefYa * 3) * W) - W)$

$Ybi = ((Ls1 + wd) - (0.00034 * a^2 * ((Ls1 + wd) / 100)^5)) * Sin(DefYb) + ((Cos(DefYb * 3) * W) - W)$

$wx = \sqrt{(wd * Lsi / Ls)^2 - (Ybi - Yai)^2}$

Segment Area = (Yai + Ybi) / 2 * wx

Ls1 = Ls1 + wd

Repeat until Ls1 = Ls
Area below spiral curve = <u>111.88952□</u>

Step 3:
Chord Area = 222.61920□ - 111.88952□ = <u>110.72968□</u>

INSIDE SPIRAL

FORMULAS

Given: a = 1, Ls = 200, X = 199.97558, Y = 2.32693 (From SC-1)
   wd = 1 (Interval distance) (Area precision is based upon the value of wd)
   wx (Segment width)

$$\text{Chord Area} = (X * Y / 2) - \sum_{Ls1=wd}^{Ls} (Ya + Yb) / 2 * wx$$

Step 1:
X * Y / 2 = 199.97558 * 2.32693 / 2 = <u>232.66459□</u>

Step 2
Summation: $\sum_{Ls1=wd}^{Ls} (Ya + Yb) / 2 * wx$

Start Ls1 = wd:

$Ya = (Ls1 - (0.00034 * a^2 * (Ls1 / 100)^5)) * Sin(a * Ls1^2 / 60000)$

$Yb = ((Ls1 + wd) - (0.00034 * a^2 * ((Ls1 + wd) / 100)^5)) * Sin(a * (Ls1 + wd)^2 / 60000)$

$wx = \sqrt{wd^2 - (Yb - Ya)^2}$

Segment Area = (Ya + Yb) / 2 * wx

Ls1 = Ls1 + wd

Repeat until Ls1 = Ls
Area below spiral curve = <u>116.31862□</u>

Step 3
Chord Area = 232.66459□ - 116.31862□ = <u>116.34597□</u>

CENTERLINE SPIRAL

FORMULAS

Given: a = 1, Ls = 200 (From SC-1); W = 100',
   Lso = 203.49061, Xo = 203.46553, Yo = 2.38785 (From SC-2)
   wd = 1 (Interval distance) (Area precision is based upon wd)
   wx (Segment width)

$$\text{Chord Area} = (Xo * Yo / 2) - \sum_{Ls1=wd}^{Ls} (Yao + Ybo) / 2 * wx$$

Step 1:
Xo * Yo / 2 = 203.46553 * 2.38785 / 2 = <u>242.92258□</u>

Step 2
Summation: $\sum_{Ls1=wd}^{Ls} (Yao + Ybo) / 2 * wx$

Start Ls1 = wd:

$DefYa = a * Ls1^2 / 60000; \quad DefYb = a * (Ls1 + wd)^2 / 60000$

$Yao = (Ls1 - (0.00034 * a^2 * (Ls1 / 100)^5)) * Sin(DefYa) + (W - (Cos(DefYa * 3) * W))$

$Ybo = ((Ls1 + wd) - (0.00034 * a^2 * ((Ls1 + wd) / 100)^5)) * Sin(DefYb) + (W - (Cos(DefYb * 3) * W))$

$wx = \sqrt{(wd * Lso / Ls)^2 - (Ybo - Yao)^2}$

Segment Area = (Yao + Ybo) / 2 * wx

Ls1 = Ls1 + wd

Repeat until Ls1 = Ls
Area below spiral curve = <u>120.82001□</u>

Step 3:
Chord Area = 242.92258□ - 120.82001□ = <u>122.10257□</u>

OUTSIDE SPIRAL

Date	Project Sur.
Jun 2011	Jim Crume
Project No.	Project Manager
ADOT Spiral	Jim Crume

SC-4
Sht 4 of 7

Default [Model]
C:\Project Files\spiral\SC sheets\SC-4.dgn