Integrating CAD with Geospatial Data to Design Bond Forfeiture Reclamation Projects

Stefanie Self and David Best

Background

- Bond forfeiture site – large site had gone through reclamation and was eligible for phase 2 bond release, though it was never applied for
- The site had been inactive for about 15 years before forfeiture
- Maintenance work was needed to repair problem areas such as:
  - Gullies/washouts
  - Acid/toxic material areas
  - Bare areas where vegetation hadn’t established

First Site Visit

- OSM-MCR staff went to the site to identify and locate maintenance features for design work using GPS technology
- Used georeferenced aerial photography and a shape file of the permit boundary to create an ArcPad project for use in the field
- Each MCR staff member had a Fujitsu tablet with the created ArcPad project and equipped with a plug-in GPS antenna

Fujitsu Tablet Computers & GPS Card

First Site Visit, cont.

- As features were located, staff entered information into ArcPad
- Length of line-type features were measured by walking beside a gully, etc. Average cross-sectional area and bed-slope of a gully were estimated and entered into the properties pop-up box. Area-type features were walked around.
- Over the course of one trip, the three staff members identified over 200 features to be repaired

Data Processing

- The shape files created in the field using ArcPad were taken from the Fujitsu tablets and imported into CAD software
- Using Autodesk's Map 3D and Raster Design along with Carlson software's SurvCADD program, the shapefiles were combined to make one map of the entire site

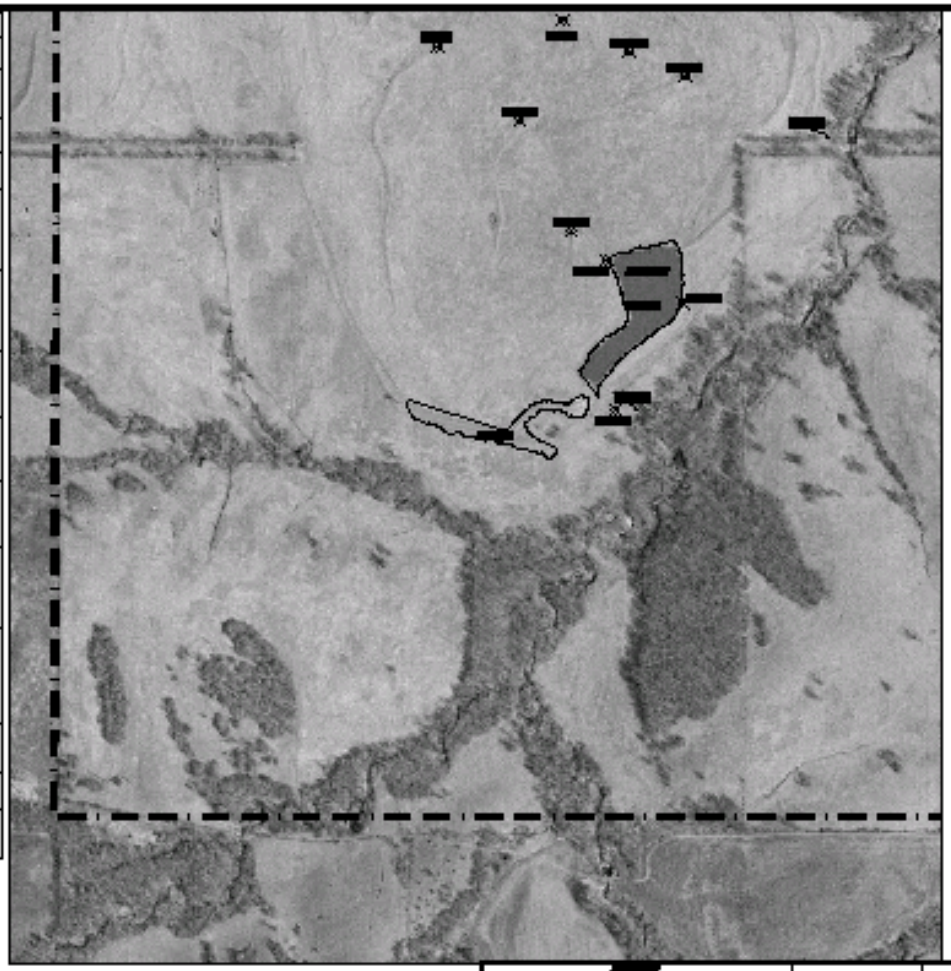
Data Processing, cont.

- In the office, using the created site map, over 200 tasks were identified for remediation work
- The design engineer then just had to read the properties to be able to describe the work required and do an engineer's estimate (done using Excel)
- Two areas were identified as needing further information to design a large regrade and create a pond in one valley

PERMIT BOUNDARY

Task List

Task	Repair Required
Task 98	Regrade area approximately 10' x 10', treat with lime, cover with topsoil and revegetate.
[redacted]	Overseed area approx. 10' x 10', with a pasture seed mix.
Task 100	Overseed area approx. 20' x 30', with a pasture seed mix.
Task 101	Repair terrace breach 20' wide x 40' long. Fill with material, shape to match existing terrace, grade to drain, and revegetate. Replace missing outlet pipe.
[redacted]	[redacted] long. Fill with material, shape to match existing terrace, grade to [redacted] missing outlet pipe.
Task 103	Repair terrace breach 50' wide x 175' long. Fill with material, shape to match existing terrace, grade to drain, and revegetate.
Task 104	Repair gully, approx 6' wide x 2' deep x 105' long. Fill with borrow, grade to drain, install 3 check dams, and revegetate
Task 105	Repair terrace outlet pipe. Excavate to find end of tile below surface, replace any damaged pipe, backfill [redacted]
Task 106	Repair erosion in pond embankment. Fill with compacted borrow, grade to match existing embankment, cover with topsoil, and revegetate
Task 107	Construct 50' wide access ramp for livestock watering access on northern or western side of pond. Slope of ramp will be no steeper than 3h:1v. Cover with topsoil and revegetate.
Task 108	Regrade approximately 1.1 ac., treat [redacted] revegetate.
Task 109	Remove and dispose of 12" HDPE pipe.
Task 110	Repair gully, approx 6' wide x 2' deep x 75' long. Fill with borrow, grade to drain, and revegetate.



SHEET 7

7 of 9

2	Engineer's Estimate										
3	Drainwayand Terrace Drains										
4	Task No.	type of repair	Number	Length (ft)	Depth (ft)	Width (ft)	Volume (CY)	Revegetation (Ac.)	Revegetation Cost	Tons	Cost
5	1	Terrace Breach		15	15	37	308	0.01	15		632
6		Gully		35	4	8	41	0.02	16		99
7	2	Gully		160	3	8	142	0.07	51		336
8		Rock Check Dams	3				0			1.0	20
9	3	Gully		170	2	6	76	0.08	55		206
10		Rock Check Dams	3							1.0	20
11	4	Terrace Outlet Pipe									50
12	10	Terrace Outlet Pipe									100
13	11	Terrace Outlet Pipe									100
14	12	Terrace Breach		3	3	4	1		15		18
15	13	Terrace Breach		10	3	10	11		15		37
16	16	Terrace Breach		5	3	2	1		15		17
17	18	Terrace Breach		18	4	15	40		15		95
18	19	Gully		35	1	4	5	0.01	15		25
19		Rock Check Dams	2							0.7	15
20	20	Terrace Breach		18	4	12	32	0.01	15		79
21	21	Gully		40	2	3	9	0.01	15		33
22		Rock Check Dams	2							0.7	15
23	22	Gully		70	3	4	31	0.01	15		77
24		Rock Check Dams	2							0.7	15
25	23	Terrace Outlet									100
26	26	Gully		55	3	12	73	0.01	15		162
27		Rock Check Dams	2							0.7	15
28	27	Gully		35	2	5	13	0.01	15		41
29		Rock Check Dams	2							0.7	15
30	28	Terrace Breach		12	3	6	8	0.01	15		31
31	29	Terrace Outlet Pipe									100
32	30	Gully		85	3	8	76	0.01	15		166
33	31	Rock Check Dams	2							0.7	15
34	33	Gully		200	3	4	89	0.01	15		193
35		Rock Check Dams	3							1.0	20
36	34	Gully		125	4	6	111	0.01	15		237
37		Rock Check Dams	2						15		
38	35	Gully		55	3	6	37	0.01	15		88
39		Rock Check Dams	2						15		

Drainway & Terrace Drains / Regrade, Overseed, Misc. / Quantities Table

Second Site Visit

- OSM-MCR staff went out for a second site visit to contour the two areas of interest
- Leica System 500 Real-Time Kinematic (RTK) survey equipment was used with Xplore tablets for the second site visit
- The increased accuracy of the RTK system (sub-foot before corrections are applied) enabled quick and easy surveying in the two areas that needed contoured

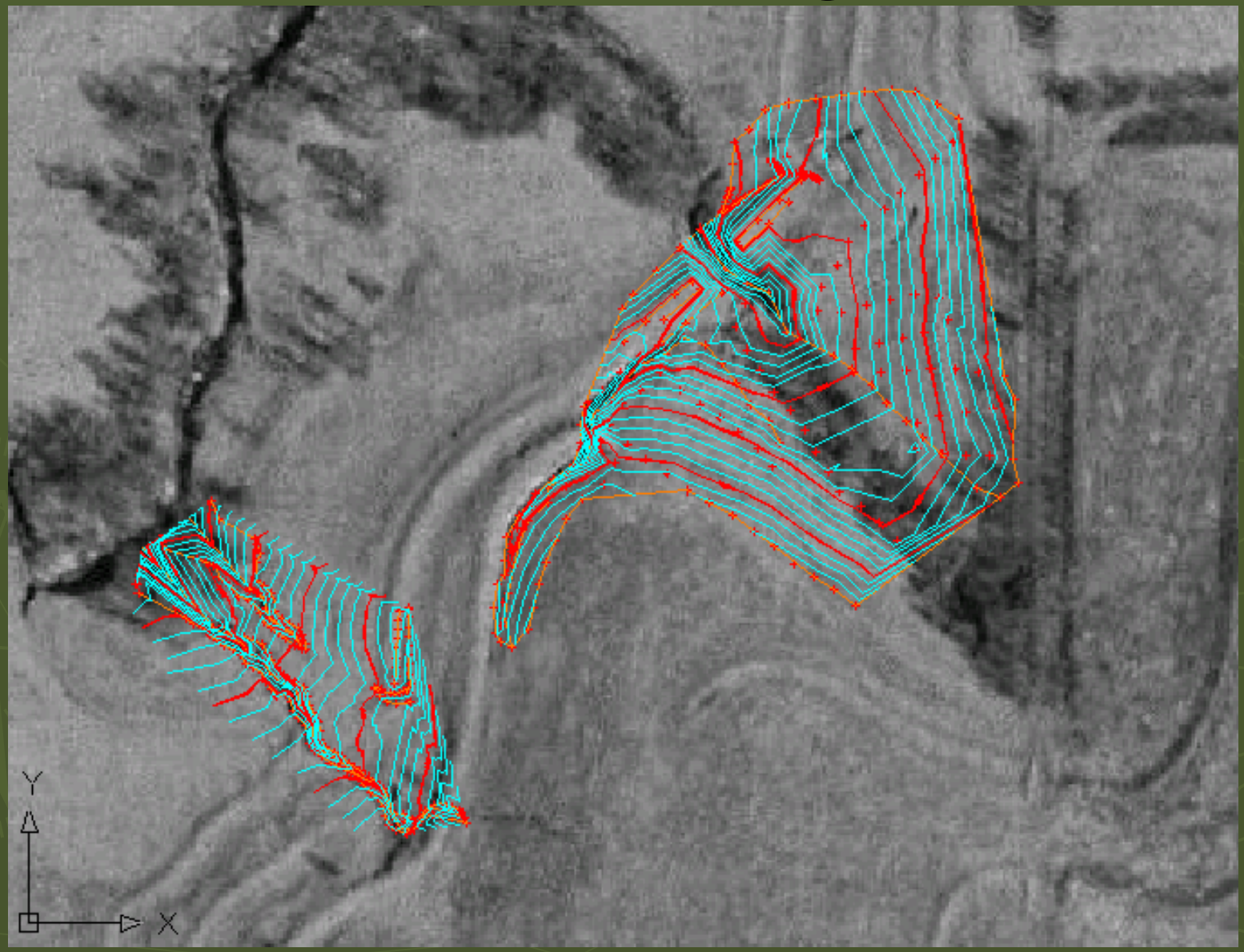
Leica's RTK 500 System

Xplore Tablet Computer

Data Processing

- Carlson Software's SurvCADD program's Field module was used with the RTK antennae to record the points directly into a .dwg file on the Xplore tablets
- SurvCADD was then used in the office to contour the existing land surface based on the RTK survey

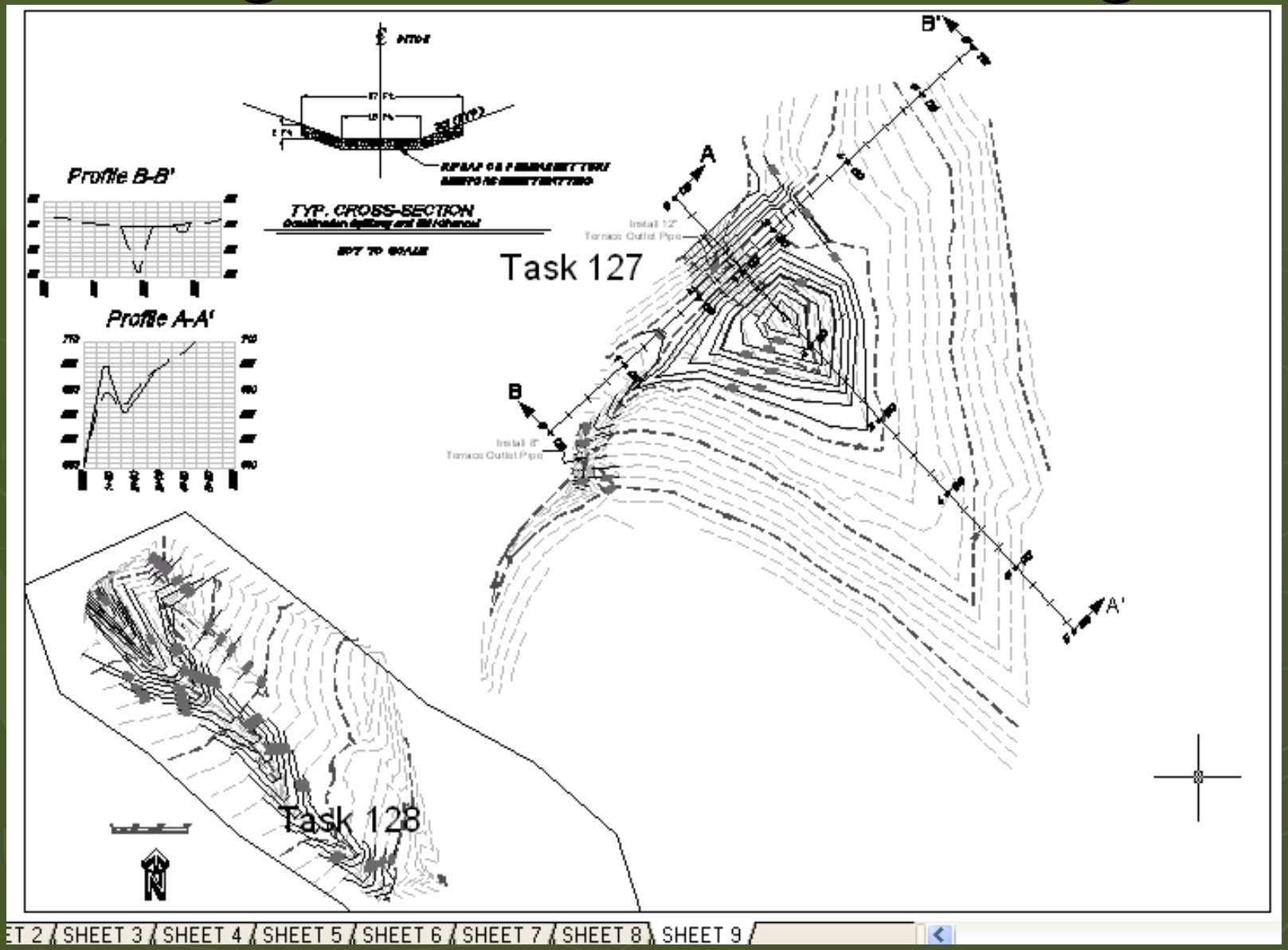
Contour of Existing Ground



Design Creation

- Using SurvCADD, the pond and regrade designs were completed and adjusted to create a volume material balance on-site
- Cross-sections and final contours were included for these two tasks in the final design submitted to the state

Regrade and Pond Design



Overview of Hardware/Software Used

- Hardware
  - Fujitsu Tablets
  - PCMCIA GPS antennae
  - Leica System 500 RTK
  - Xplore Tablets
- Software
  - ESRI's ArcPad
  - Autodesk's Map 3D and Raster Design
  - Carlson Software's SurvCADD package

Conclusion

- Using a variety of software and hardware, OSM-MCR staff conducted two surveys of a large bond forfeiture site and created a design for the state agency
- The use of these tools significantly reduced the amount of time and cost for the design of the site
  - 2 full days on site to complete all reconnaissance and create a complete site map vs. the weeks of traditional surveying that would have been necessary

Acknowledgements

- OSM staff in the field:
  - Randall Mills
  - Kevin Garnett
- State staff in the field:
  - Dharmvir Bhatnagar

Questions?