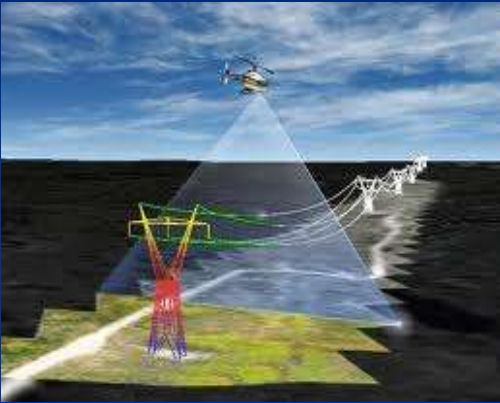


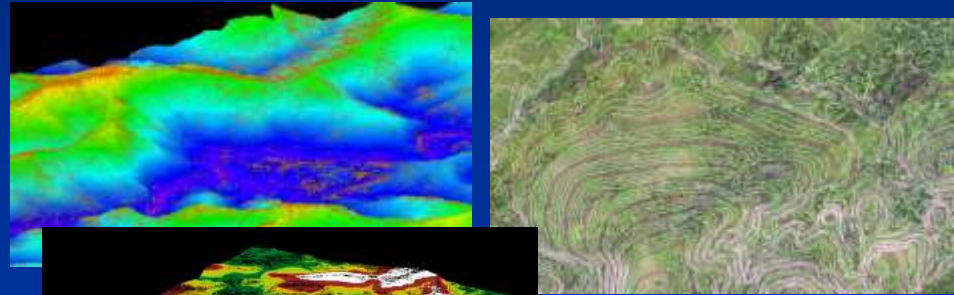
GROUND DATA SOLUTIONS R&D SDN BHD

Co. No-710842-H

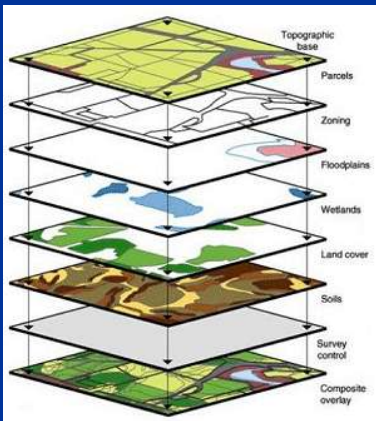
AIRBORNE LASER MAPPING



REMOTE SENSING



GEOGRAPHIC INFORMATION SYSTEM (GIS)



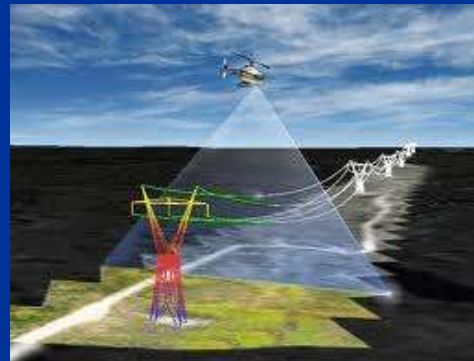
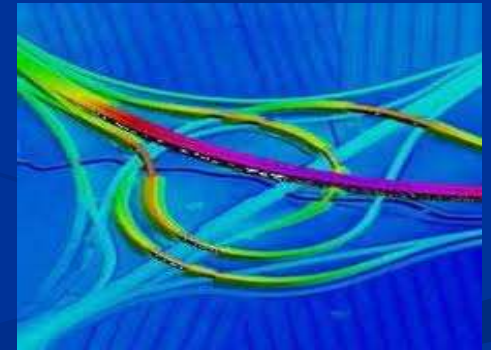
AIRBORNE LIDAR TECHNOLOGY FOR UTILITY MAPPING

ENGINEERING SURVEY



PRESENTATION OVERVIEW

- WHO IS GDS
- GDS' MATRIX SURVEY SYSTEM
- NEWEST SENSORS
- BENEFITS OF GDS' MATRIX SURVEY SYSTEM
- ADVANTAGES OF LIDAR FOR UTILITIES
- GDS EXPERIENCE LIST IN UTILITIES
- CASE STUDIES
- SOLUTION FOR LIDAR DATA MANAGEMENT
- CONCLUSIONS



TRUDY R. GANENDRA



- **MANAGING DIRECTOR - GROUND DATA SOLUTIONS R&D SDN BHD
PIONEERS IN THE FIELD WITH ONGOING R&D: BUILDS AND
OPERATES OWN LIDAR SURVEY SYSTEMS, UTILIZING THE
LATEST WAVEFORM LASERS AND SENSORS. PROVIDER OF
COMPLETE GEOMATICS AND ENGINEERING SOLUTIONS**
- **M.Eng., M.A. Hons (Cantab), MSc., DIC**
- **14 YEARS OF LIDAR EXPERIENCE WITH 80 PROJECTS COMPLETED**



WHO IS GDS ?

- 100% MALAYSIAN LIDAR SERVICE PROVIDER
- OVER 25 YEARS OF LIDAR EXPERIENCE
- OVER 100 SUCCESSFULLY COMPLETED PROJECTS WORLDWIDE
- PIONEER PROVIDER WHO OWN, BUILD AND OPERATE LIDAR SURVEY SYSTEMS
- ON GOING R&D UTILIZING THE LATEST WAVEFORM LASERS AND OTHER SENSORS
- DATA ACQUISITION AND PROCESSING PERFORMED LOCALLY
- CURRENTLY OPERATING 4 LIDAR SYSTEMS
- PROVIDE TOTAL GEOMATICS AND ENGINEERING SOLUTIONS
- PROVIDE HIGHEST LIDAR AND AERIAL PHOTGRAPHIC RESOLUTION IN SOUTHEAST ASIA
- MULTIMEDIA SUPER CORRIDOR (MSC) STATUS COMPANY
- RECEIVED ISO 9001:2008 CERTIFICATE



EVOLUTION OF GDS

1989

CONTRACTED SERVICES FROM CANADIAN TECHNOLOGY PROVIDER



1991

SET UP 51% MALAYSIAN, 49% CANADIAN JOINT VENTURE WITH EXCLUSIVE RIGHTS IN ASIA



1997

BOUGHT OVER 100% OF THE JOINT VENTURE COMPANY



2002

BOUGHT OVER 50% OF THE CANADIAN TECHNOLOGY PROVIDER



2008

SET-UP MULTIMEDIA SUPER CORRIDOR (MSC) COMPANY



2012

RECEIVED ISO 9001:2008 CERTIFICATION

GDS' MATRIX SURVEY SYSTEM

GDS' MATRIX IS:-

- LATEST AIRBORNE LASER & IMAGERY SYSTEM, DEVELOPED BY MALAYSIAN & CANADIAN TECHNOLOGISTS
- UNIQUE MULTIPLE MOUNTING MAPPING SYSTEM – HELICOPTER AND FIXED WING ENABLED
- “HOT SWAPPABLE” SYSTEM :
 - 6 TYPES OF SCANNER (INCLUDING 4 WAVEFORM LASER)
 - 4 TYPES OF INERTIAL MEASUREMENT UNIT
 - 8 TYPES OF HIGH RESOLUTION CAMERAS
 - 2 TYPES OF HIGH DEFINITION VIDEO CAMERAS
 - 2 TYPES OF HIGH-ACCURACY ONBOARD GPS RECEIVERS



GPS ANTENNA



MATRIX'S CONTROLLER



OPERATOR CONSOLE



SENSOR'S COMPARTMENT



NEWEST SENSORS

RIEGL LMS-Q780 CAMERA

- Full waveform analysis for unlimited number of target echoes
- High laser pulse repetition rate up to 400 kHz
- High ranging accuracy 20 mm



PHASE ONE CAMERA

- Built to meet the exacting needs of aerial photography and streamline capture and processing
- Metric camera Phase One for detailed small and large scale mapping projects
- Camera resolution is up to 80 MP



BENEFITS OF GDS' MATRIX SURVEY SYSTEM

- **DESIGNED, BUILT, OWNED AND OPERATED BY MALAYSIANS**
- **UTILIZED LATEST WAVEFORM LASER – UP TO 400,000 HZ**
- **SUCCESSFULLY COMPLETED OVER 100 PROJECTS WORLDWIDE**
- **ROBUST AGAINST WEATHER CONDITIONS, SUCH AS MONSOONS AND LOW LYING CLOUDS**
- **COST: VERY EFFECTIVE FOR MEDIUM TO LARGE MAPPING AREA/ CORRIDOR**
- **TIME: FAST DATA COLLECTION**
- **DISCRETION: NEGLIGIBLE IMPACT ON THE ENVIRONMENT AND NO LAND INTRUSION**
- **DIGITAL IMAGERY: CLOUD FREE IMAGERY: ALLOWS FOR IDENTIFICATION & CLASSIFICATION OF FEATURES & VEGETATION**
- **HIGH DENSITY AND ACCURATE DIGITAL PRODUCTS**



ADVANTAGES OF LIDAR FOR UTILITIES

- **MAXIMIZES ACCURACY AND DENSITY OF TOPOGRAPHICAL AND DIGITAL IMAGERY DATA**
- **MINIMIZES SURVEY TIME AND COST**
- **MOST COST EFFECTIVE DESIGN OF INFRASTRUCTURE, MINIMIZING EARTHWORKS AND QUANTITIES WHILE MAXIMIZING VALUE**
- **DAM VOLUME MEASUREMENT**
- **SLOPE STABILITY STUDY**
- **OPTIMIZES INFRASTRUCTURE DESIGN INCLUDING ACCESS ROUTES**
- **SEDIMENTATION ANALYSIS**
- **COST EFFECTIVE AND INFRASTRUCTURE MANAGEMENT**
- **ACCURATE CATCHMENT AND FLOW RATE MEASUREMENT AND MANAGEMENT**
- **ONLY LIDAR TECHNOLOGY IS ABLE TO MAP ALL OBSTRUCTIONS IN 3D OF THE CATENARIES OF EXISTING TRANSMISSION LINES WHICH ARE CRUCIAL ELEMENTS FOR TRANSMISSION LINE MANAGEMENT AND DESIGN**
- **VERY HILLY, HEAVILY VEGETATED AND DIFFICULT TO ACCESS AREAS ARE PROBLEMATIC FOR LAND SURVEYORS BUT DO NOT AFFECT LIDAR SURVEY**
- **DATA FULLY DIGITAL AND HIGHLY ADAPTABLE FOR DIFFERENT USES, FORMATS & TRANSFORMATION MODELS AND SOFTWARE**



GDS EXPERIENCE LIST IN UTILITIES

GDS HAS SUCCESSFULLY COMPLETED :-

- **8 PROJECTS IN HYDROPOWER**
- **8 PROJECTS IN WATER CATCHMENTS**
- **24 PROJECTS IN TRANSMISSION LINE**

RECENT UTILITIES SURVEY PROJECTS COMPLETED BY GDS:

- **AIRBORNE LASER AND DIGITAL TOPOGRAPHICAL SURVEY FOR MINI HYDRO, TERENGGANU**
- **TELOM HYDROELECTRIC PROJECT FEASIBILITY STUDY**
- **LIDAR MAPPING AND AERIAL PHOTOGRAPHY FOR RESERVOIR AREA OF MURUM HYDROELECTRIC PROJECT**
- **LIDAR MAPPING AND AERIAL PHOTOGRAPHY FOR THE PROPOSED BELAGA AND LINAU HYDROPOWER PROJECTS**
- **LIDAR MAPPING AND AERIAL PHOTOGRAPHY FOR PROPOSED HYDROPOWER DEVELOPMENT PROJECTS, SARAWAK**
- **AIRBORNE LIDAR AND IMEGERY SURVEY FOR SG. KEDAMAIAN DAM AND IMPOUNDING RESERVOIR KOTA BELUD, SABAH**
- **AIRBORNE LIDAR , DIGITAL IMAGERY AND LAND SURVEY FOR TANJUNG TOHOR YONG PENG, JOHOR**
- **LIDAR SURVEY FOR THE 275KV CAMERON HIGHLAND TO TAPAH AND 500KV TAPAH TO BENTONG PROJECT**
- **MANITOBA HYDRO THERMAL RATING ASSESSMENT, CANADA**
- **ATC SPRING 2015 - CANADA**
- **ALTALINK WAINWRIGHT - CANADA**



CASE STUDY 1

NEW TRANSMISSION LINE ALIGNMENT DESIGN

- **NAME OF PROJECT: 275KV ULU JELAI TO TAPAH & 500KV FROM TAPAH TO BENTONG LIDAR SURVEY PROJECT SUMMARY**
- **PROJECT AREA 190.462km x 0.5km**
 - 139.124km (TAPAH TO BENTONG)
 - 51.388km (ULU JELAI TO TAPAH)
- **GPS STATIC - 3 DAYS**
- **LIDAR DATA ACQUISITION - 14 DAYS**
- **DTM/DEM & CONTOUR DELIVERED**
 - 11 DAYS AFTER AIRBORNE ACQUISITION COMPLETED
- **FINAL MAPPING & ORTHOPHOTO MOSAIC DELIVERED**
 - 35 DAYS AFTER AIRBORNE ACQUISITION COMPLETED
- **LIDAR DENSITY : MORE THAN 1.1 MILLION POINTS IN 1km X 0.55km (2 POINTS / m²)**
- **LIDAR POINTS HITTING THE GROUND : MORE THAN 49,000 POINTS IN 1km X 0.55km (0.1 POINTS /m²)**
- **AVERAGE POINTS SPACING FOR POINTS REACHING TO GROUND LEVEL : 3m**



CASE STUDY 1

NEW TRANSMISSION LINE ALIGNMENT DESIGN

A COMPARISON WAS MADE BETWEEN CONVENTIONAL TRANSMISSION ROUTE ALIGNMENT DESIGN AND DESIGN USING PLS-CADD & LiDAR.

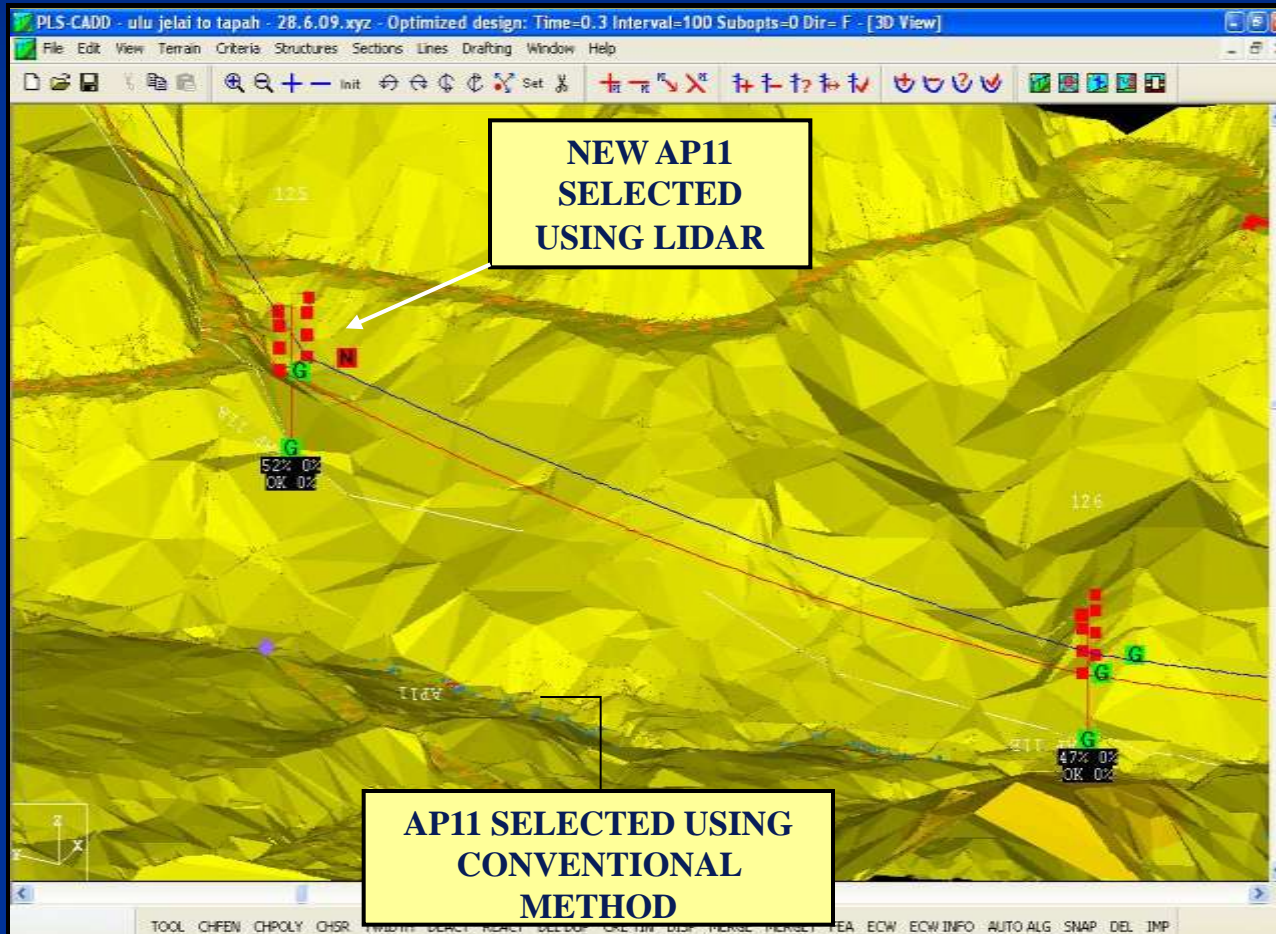
SOME EXAMPLES OF PROBLEMS WHICH OCCURRED DUE TO CONVENTIONAL DESIGN METHODOLOGY ACCURACY AND DATA BEING SPARCE:

- PROBLEM 1: RIVER CROSSING**
- PROBLEM 2: EXISTING TRANSMISSION LINE CROSSING**
- PROBLEM 3: HILLY TERRAIN**



CASE STUDY 1

NEW TRANSMISSION LINE ALIGNMENT DESIGN



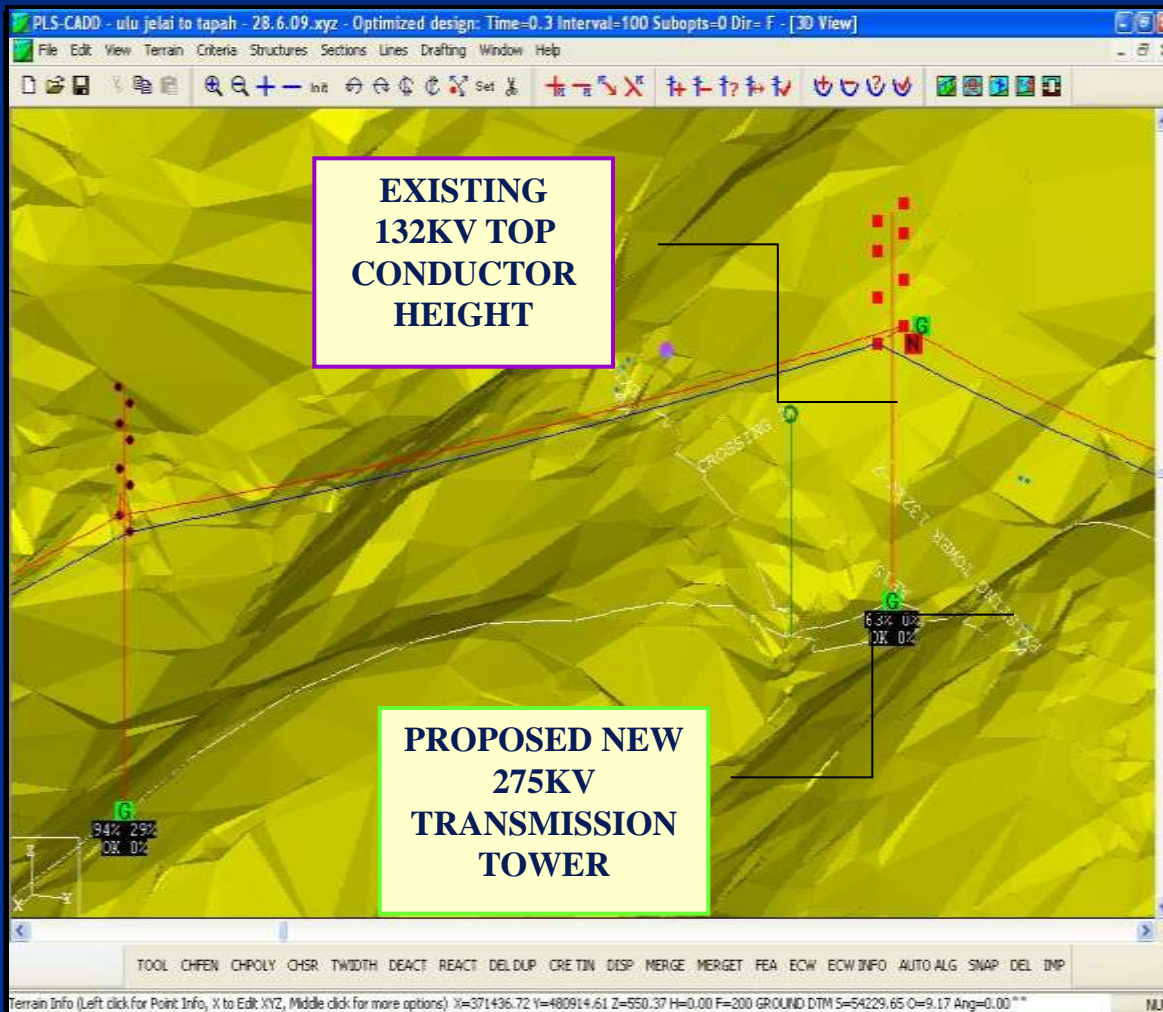
PROBLEM 1: RIVER CROSSING

- THE LOCATION OF AP11 SELECTED BY CONVENTIONAL DESIGN WAS FOUND TO BE WITHIN RIVER DURING GROUND SURVEY WORKS
- DESIGN WITH PLS-CADD AND LIDAR CHOSE A BETTER LOCATION



CASE STUDY 1

NEW TRANSMISSION LINE ALIGNMENT DESIGN



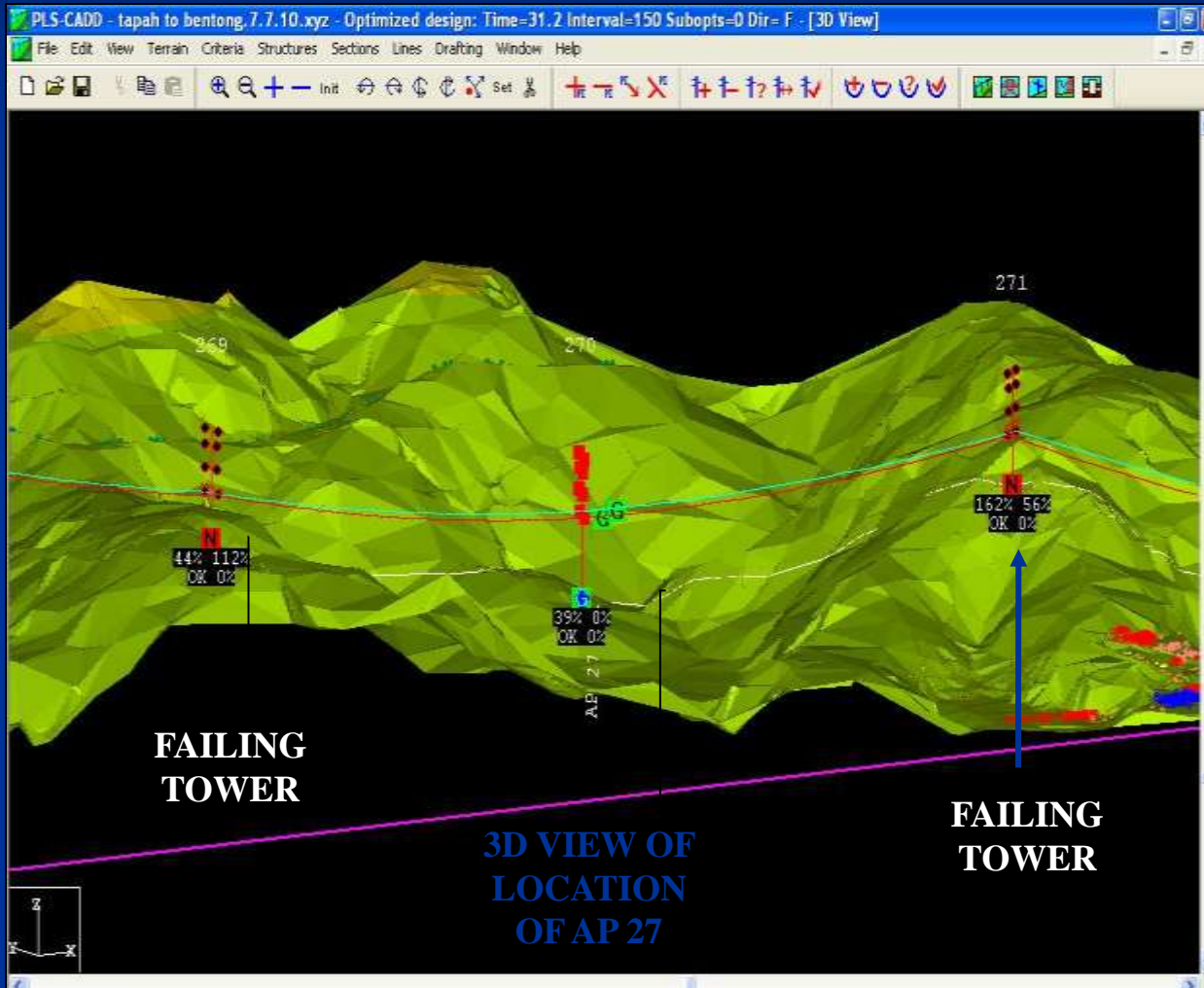
PROBLEM 2: IDENTIFICATION OF CROSSINGS

- CONVENTIONAL METHOD CANNOT IDENTIFY THE BEST LOCATION FOR ANGLE POINT WHERE THE PROPOSED ALIGNMENT CROSSES EXISTING TRANSMISSION LINES
- LIDAR HAS THE ABILITY TO IDENTIFY EXISTING TRANSMISSION LINES AND OTHER CROSSINGS WHICH ARE CRUCIAL ELEMENTS IN TOWER SPOTTING, THUS REDUCES PROJECT COST AND TIME



CASE STUDY 1

NEW TRANSMISSION LINE ALIGNMENT DESIGN



PROBLEM 3: HILLY TERRAIN

- CONVENTIONAL METHOD PLACED APS IN LOCATIONS NEEDING SPECIAL TOWERS WHICH ARE VERY EXPENSIVE AND DIFFICULT TO CONSTRUCT
- LIDAR ENABLES 3D VIEWING OF THE TERRAIN, LEADING TO QUICK AND EASY TOWER SPOTTING FOR MOST COST EFFECTIVE DESIGN

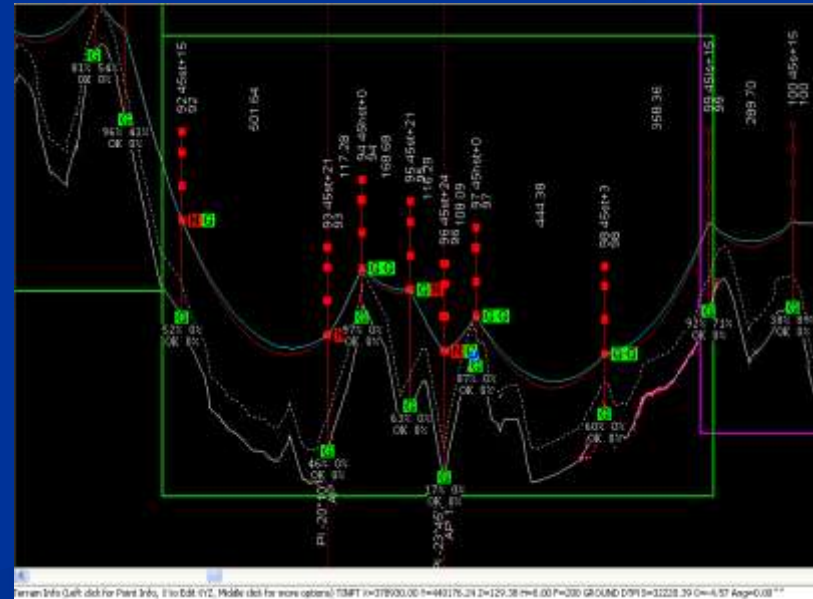


CASE STUDY 1

TOWER SPOTTING FOR NEW TRANSMISSION LINE USING PLS-CADD's OPTIMUM SPOTTING

IN CONCLUSION, LIDAR AND PLS-CADD SOFTWARE PROVIDES FOR OPTIMIZED DESIGN OF NEW TRANSMISSION LINE ROUTE BY CALCULATING COSTS AND EFFECTS OF VARIOUS INPUTS SUCH AS:

- CONDUCTOR TYPE
- STRUCTURE TYPE
- SAFETY FACTOR
- CLEARANCES
- SAG – TENSION LIMITING CONDITIONS
- ALLOWABLE WIND AND WEIGHT SPAN



CASE STUDY 2

TRANSMISSION LINE RE-RATING AND UPGRADE

PROJECT DESCRIPTION:

- 330 KM (205 MILES) OF 115 KV T/L IN CANADA
- CONDUCTOR RANGED FROM 266.8, 336.6 AND 795 MCM
- SCC LINE RATINGS BASED ON ORIGINAL LINE DATA

REASON FOR SURVEY:

- RECORDS LOST OR INCOMPLETE
- MAJORITY OF LINES 70 YEARS OLD

PROJECT OBJECTIVES:

- EVALUATE AND VERIFY EXISTING DESIGNS
- INCREASE LINE RATING FROM ??°C TO 100°C
- DEVELOP AN “UPGRADE SYSTEM” NOT JUST AN INDIVIDUAL LINE PLAN



CASE STUDY 2

TRANSMISSION LINE RE-RATING AND UPGRADE

ORIGINAL DESIGN:

- 50°C MAXIMUM THERMAL RATING, 37 MW CAPACITY AT 38°C AMBIENT & 2 FT/SEC WIND (SUMMER RATING)

LIDAR DATA VERIFICATION:

- 56°C MAXIMUM THERMAL RATING, 52 MW CAPACITY AT 38°C AMBIENT & 2 FT/SEC WIND
- CONFIRMED ORIGINAL DESIGN RATING
- PROCEED TO N&T ANALYSIS



CASE STUDY 2

TRANSMISSION LINE RE-RATING AND UPGRADE

NIP&TUCK ANALYSIS

- ONLY THREE SPANS LIMITED LINE TO 56°C RATING
- ALL OTHER SPANS RATED TO 100°C
THREE “NIPS” OF 30 – 35 CM (1 FT) REQUIRED
- ONLY BOTTOM CONDUCTOR REQUIRED “NIP”
- ADEQUATE CLEARANCE BETWEEN PHASES
- REDUCED EFFECT ON DEAD END TOWERS
- TENSION INCREASE VARIED FROM 5% TO 8%
- EXISTING VIBRATION DAMPERS CHECKED



CASE STUDY 3

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECTS

- **2012 PROJECT: LIDAR MAPPING AND AERIAL PHOTOGRAPHY FOR PROPOSED HYDROPOWER DEVELOPMENT PROJECTS, PELAGUS, SARAWAK**
- **PROJECT AREA : 9 AREAS TOTALING 4028.884 km²**
- **AIRBORNE SURVEY : 25 WEEKS**
- **DTM/DEM DELIVERED : 14 WEEKS**
- **ORTHOPHOTO MOSAIC DELIVERED : 13 WEEKS**

- **2013 OF PROJECT: LIDAR MAPPING AND AERIAL PHOTOGRAPHY FOR RESERVOIR AREA OF MURUM HYDROELECTRIC PROJECT, SARAWAK**
- **PROJECT AREA: 950 KM²**
- **GPS STATIC : 9 DAYS**
- **LIDAR DATA ACQUISITION : 7 DAYS**
- **DTM/DEM & CONTOUR PROCESSING : 4 WEEKS**



CASE STUDY 3

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECT

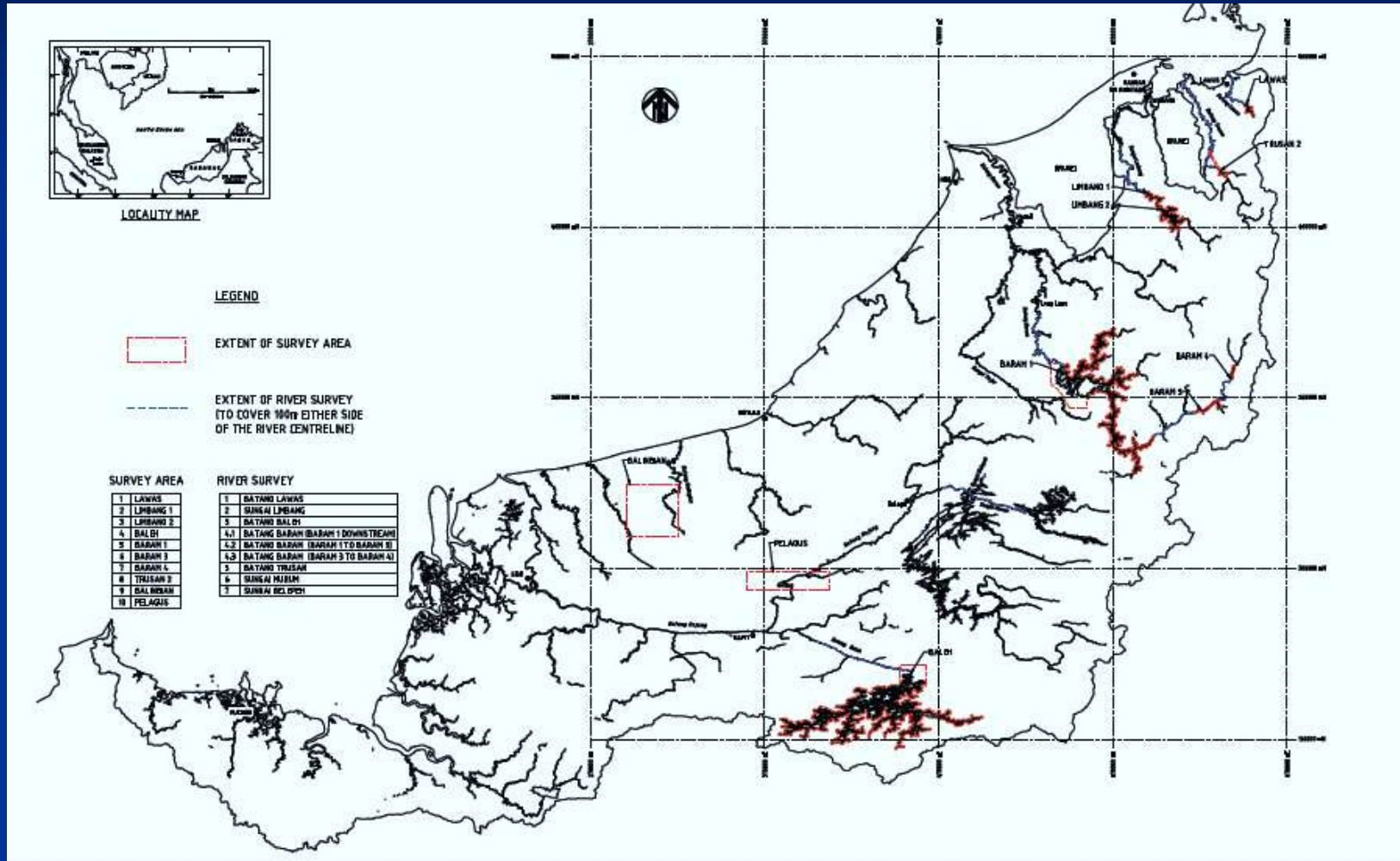
- 2014 PROJECT: LIDAR MAPPING AND AERIAL PHOTOGRAPHY FOR THE PROPOSED BELAGA AND LINAU HYDROPOWER PROJECTS, SARAWAK
- PROJECT AREA: 650 KM²
- GPS STATIC : 10 DAYS
- LIDAR DATA ACQUISITION : 10 DAYS
- DTM/DEM & CONTOUR DELIVERED: 4 WEEKS
- FINAL DELIVERABLES, WATER FLOW / DRAINAGE FLOW: 7 WEEKS

- LIDAR DENSITY :
 - BETWEEN 2,203,996 POINTS (2.20 POINTS / m²) AND > 18 MILLION POINTS (18.55 POINTS / m²) IN 1KM X 1KM
- LIDAR POINTS HITTING THE GROUND :
 - BETWEEN 48,357 POINTS (0.04 POINTS / m²) AND 1,074,977 POINTS (1.1 POINTS / m²) IN 1KM X 1KM
- AVERAGE POINTS SPACING FOR POINTS REACHING THE GROUND LEVEL :
 - BETWEEN 1.0m AND 5m



CASE STUDY 3

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECT



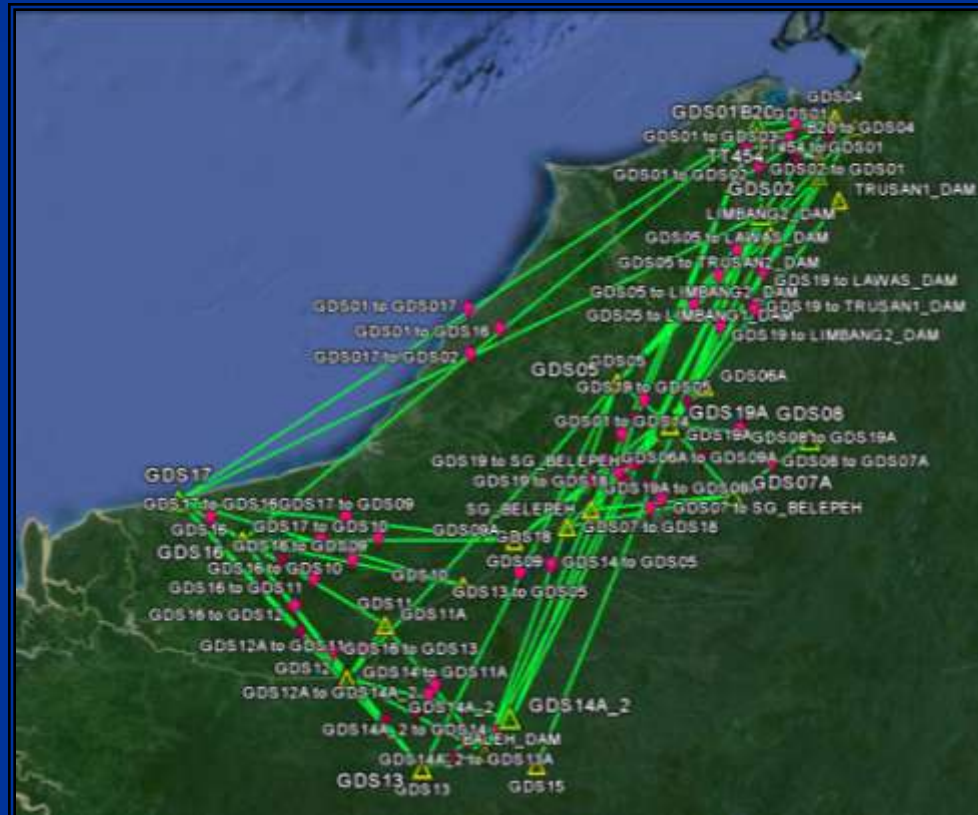
PROJECT AREA OF LIDAR MAPPING AND AERIAL PHOTOGRAPHY FOR PROPOSED HYDROPOWER DEVELOPMENT PROJECTS, SARAWAK



CASE STUDY 3

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECT

USE OF CONTINUOUSLY OPERATING REFERENCE STATION (CORS) AND LIDAR WAS INSTRUMENTAL IN ENSURING ACCURACY COULD BE MAINTAINED OVER LONG DISTANCES AND OVER SEVERAL YEARS



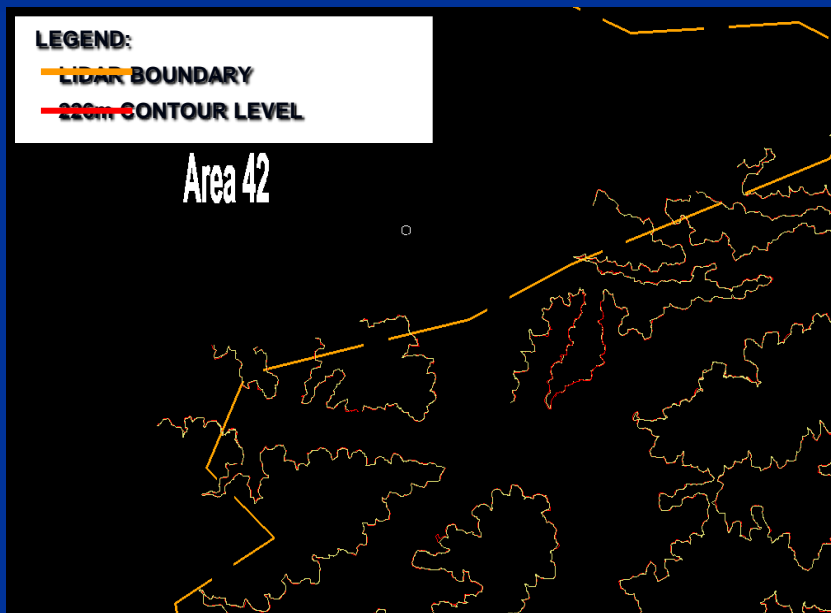
STATIC GPS NETWORK



CASE STUDY 3

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECT

LIDAR WAS SEEN TO CAPTURE DAM INUNDATION AREA MORE ACCURATELY THAN CONSERVATIVE ESTIMATES USING TOPOMAPS LIDAR THAT SHOWED MANY AREAS THAT WERE PRESUMED OUTSIDE THE DAM INUNDATION AREA, WOULD BE FLOODED, LEADING TO RE-EVALUATION OF LAND COMPENSATION ISSUES



ORIGINAL SURVEY BOUNDARY DERIVED FROM JUPEM TOPOMAP WHICH ESTIMATED THE DAM INUNDATION AREA

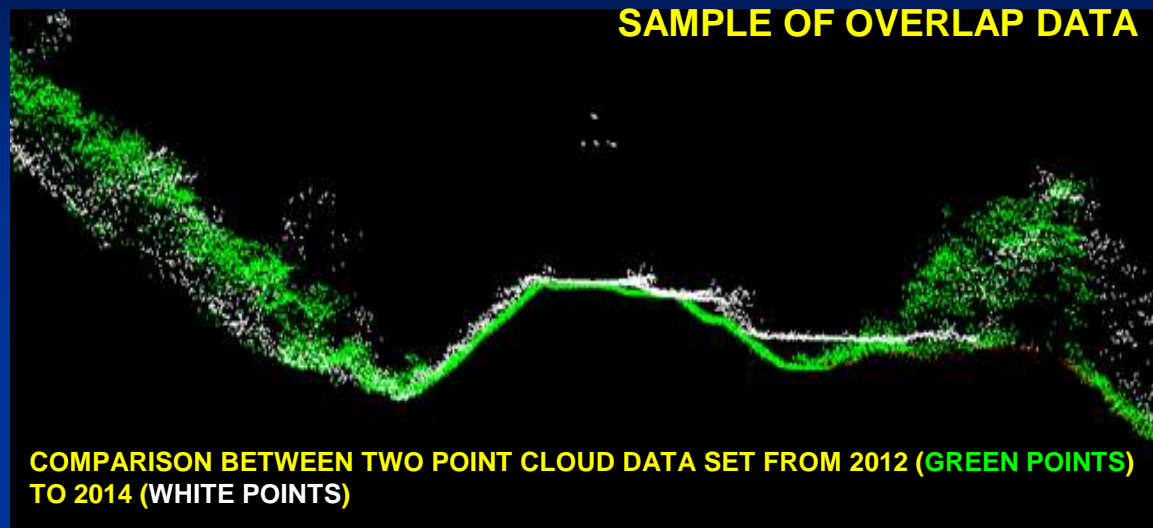


THE ACTUAL INUNDATION AREA CAPTURED BY LIDAR



CASE STUDY 3

SIGNIFICANT CHANGES IN TOPOGRAPHY WITHIN 2 YEARS WERE CAPTURED BY LiDAR



DUE TO SOME OVERLAPPING AREA FOR LiDAR SURVEYS IN 2012 AND 2014, THE OVERLAP AREAS PROVIDE USEFUL CHANGE DETECTION INFORMATION SUCH AS:

- CANOPY HEIGHT MODEL (CHM)
- SOIL EROSIONS
- MAN-MADE AND NATURAL TOPOGRAPHICAL CHANGES

CASE STUDY 3

CHANGES IN TOPOGRAPHY WITHIN 2 YEARS

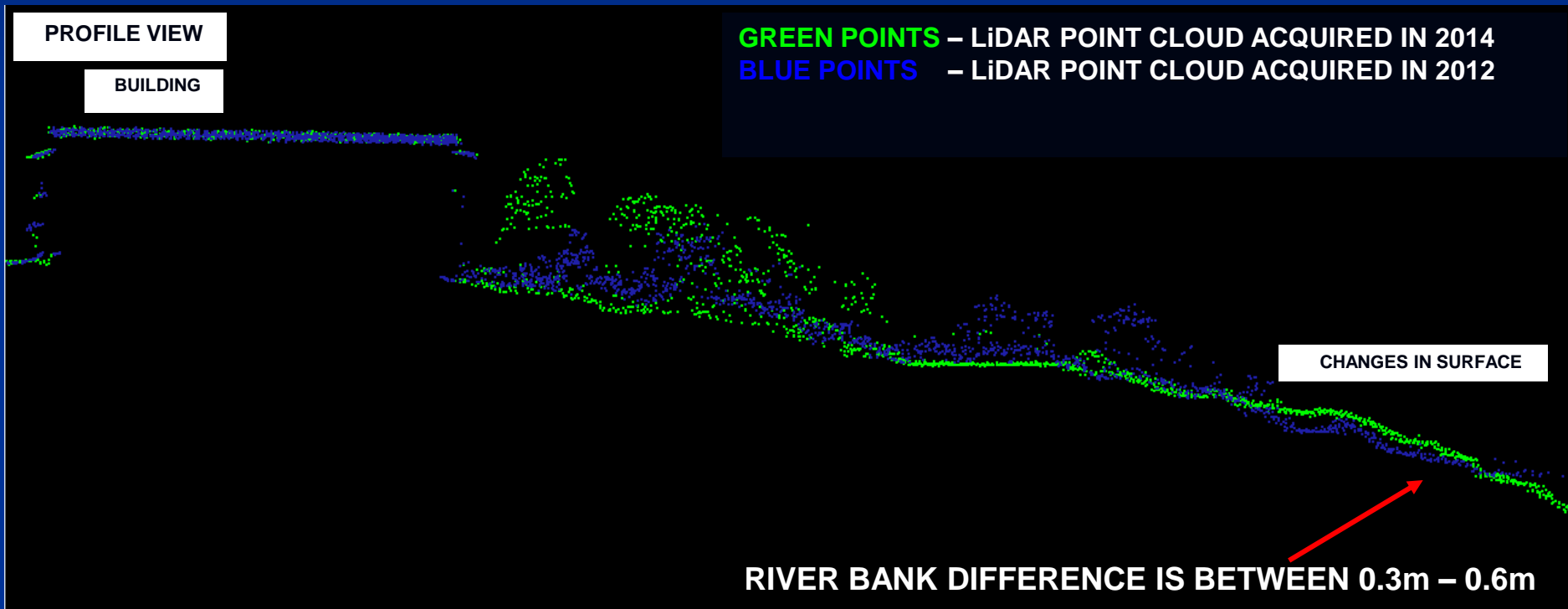
PROFILE VIEW

BUILDING

GREEN POINTS – LiDAR POINT CLOUD ACQUIRED IN 2014
BLUE POINTS – LiDAR POINT CLOUD ACQUIRED IN 2012

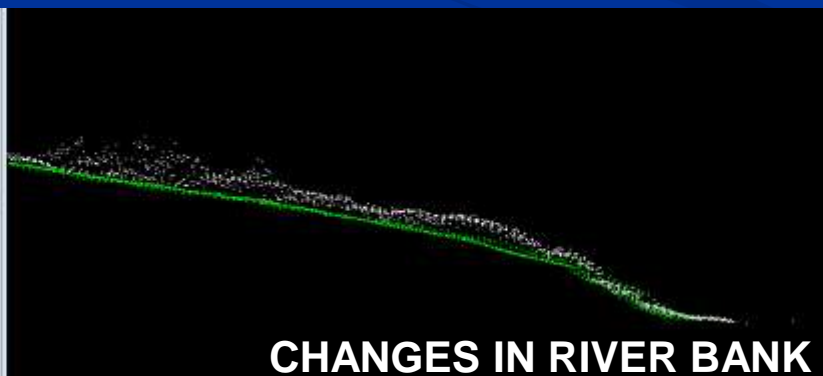
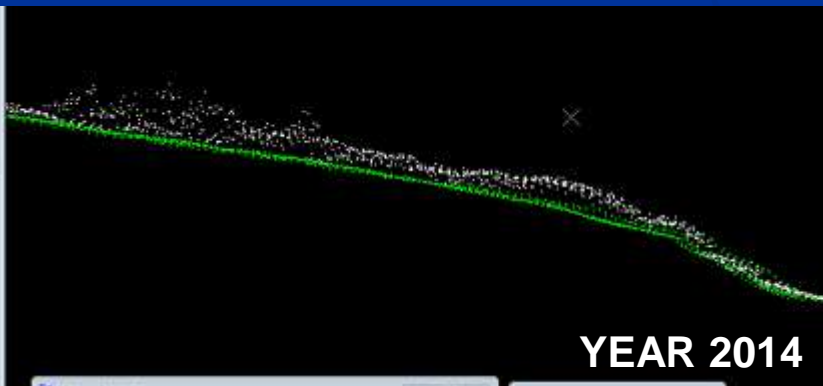
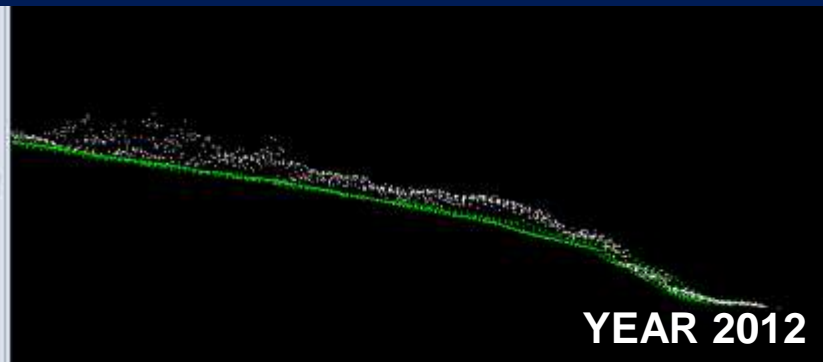
CHANGES IN SURFACE

RIVER BANK DIFFERENCE IS BETWEEN 0.3m – 0.6m



CASE STUDY 3

CHANGES IN TOPOGRAPHY WITHIN 2 YEARS



CASE STUDY 3

CHANGES IN TOPOGRAPHY WITHIN 2 YEARS

SAMPLE OF OVERLAP DATA

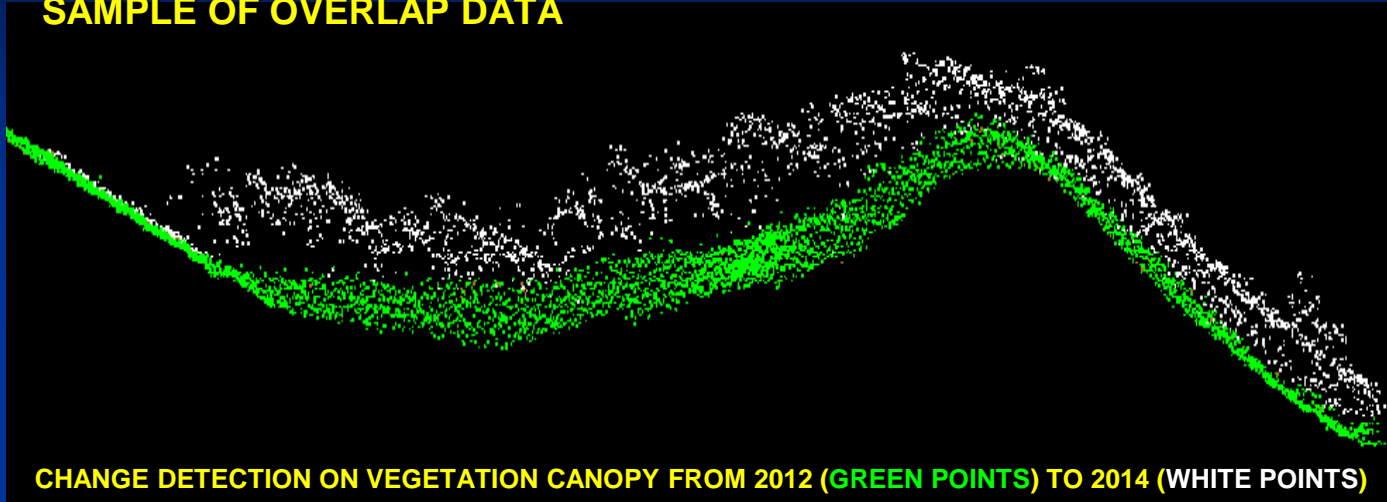
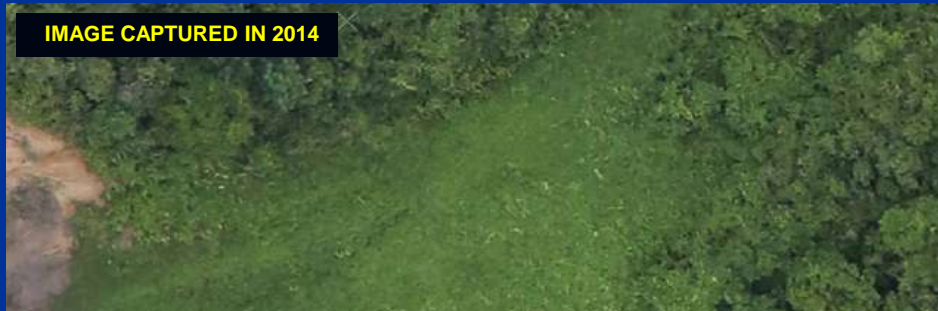


IMAGE CAPTURED IN 2012



IMAGE CAPTURED IN 2014



CASE STUDY 3

CHANGES IN TOPOGRAPHY WITHIN 2 YEARS

SAMPLE OF OVERLAP DATA



DURING ROAD CONSTRUCTION (2012)



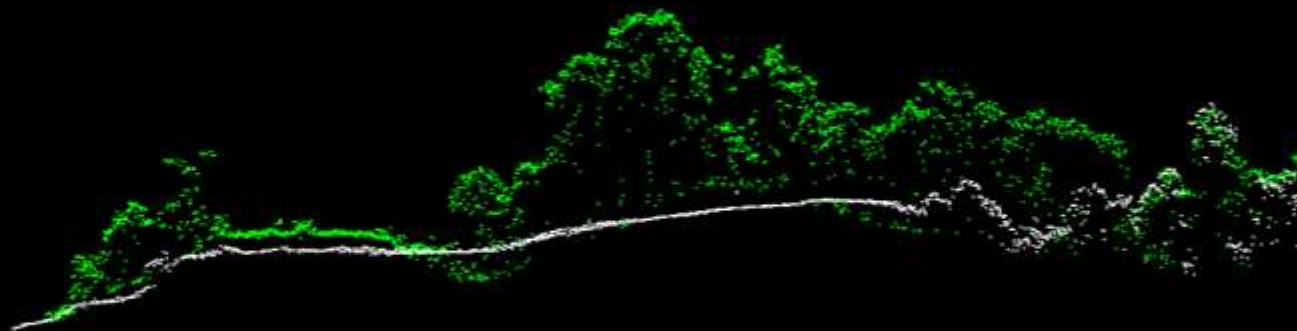
AFTER ROAD CONSTRUCTION (2014)



CASE STUDY 3

CHANGES IN TOPOGRAPHY WITHIN 2 YEARS

SAMPLE OF OVERLAP DATA



LIDAR POINT CLOUD PROFILE IN 2012 (GREEN POINTS) AND 2014 (WHITE POINTS)

BEFORE NEW ROAD DEVELOPMENT (2012)



AFTER NEW ROAD DEVELOPMENT (2014)



CASE STUDY 3

PROPOSED HYDROPOWER DAM DEVELOPMENT PROJECT

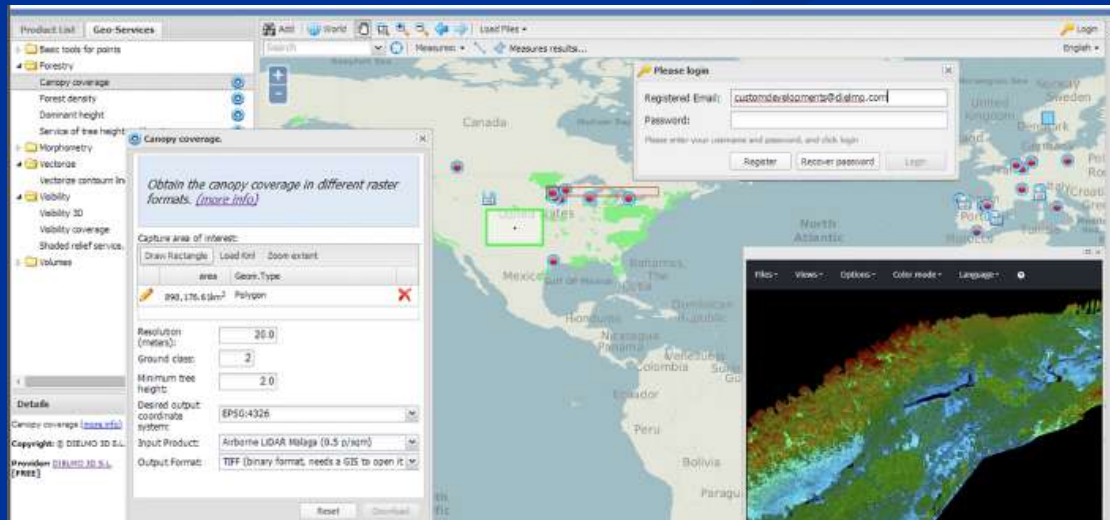
- VOLUME CALCULATIONS WERE PERFORMED USING TERRA MODELER, VIA THE “COMPUTE QUANTITY” TOOL
- THREE SAMPLES WERE TAKEN FROM THREE DIFFERENT LOCATIONS WITHIN THE PROJECT AREA, AND THE VOLUME CALCULATION WAS PERFORMED USING TERRA MODELER AND MANUALLY
- THE DIFFERENCE IN THE VOLUMES CALCULATED WERE 0.087%, 0.162%, AND 0.015% EACH, INDICATING THAT THE TERRA MODELER CALCULATION IS RELIABLE AND DEFINITELY MUCH FASTER

SOFTWARE	SAMPLE 1 (M3)	SAMPLE 2 (M3)	SAMPLE 3 (M3)
TERRA MODELLER	5,118,595.20	4,749,489.20	2,070,011.50
MANUAL VOLUME CALCULATION AFTER EXCLUDE THE SMALL HILLS	5,114,139.41	4,757,179.55	2,069,697.67
DIFFERENCE BETWEEN MANUAL CALCULATION AND TERRA MODELLER	4,455.79	7,690.35	313.83
DIFFERENCE % (ALL LESS THAN 1% DIFFERENCE)	0.087	0.162	0.015

SOLUTION FOR DATA MANAGEMENT SYSTEM

DATA MANAGEMENT SYSTEM IS A TECHNOLOGY THAT SUPPORTS:

- Data archiving
- Data management
- Data security
- Data sharing
- Data sales management
- Online access, visualize and analyze of LIDAR data, raster, vector, imagery and files information



SOLUTION FOR DATA MANAGEMENT SYSTEM: SERVER TECHNOLOGY

A SERVER TECHNOLOGY ALLOWS:

- **Hosting unlimited amounts of LIDAR data, GIS and any datasets (raster, vector, files, etc.)**
- **Remote access through any client web browsers, GIS software or mobile devices at an incredible performance**
- **Secured data sharing for your company, your clients or projects**

OFFERS 2 TYPES OF GEOSPATIAL DATA SERVERS:

- **SERVER TECHNOLOGY (WEB MAPPING SERVICE TECHNOLOGY)**
 - **Online viewer capabilities, cloud storage, data management, data sharing, data sales management**
 - **Online point cloud visualization in 2D & 3D**
- **FILES SERVER**
 - **Server to host and serve geolocated files (2D map)**
 - **Cloud storage and download LIDAR data, raster, vector, imagery and files information (documents, PDF , txt, etc.)**



CONCLUSION

GDS HAS COMPLETED OVER 40 PROJECTS FOR UTILITIES INDUSTRIES, ENABLING ITS CLIENTS TO ACHIEVE THE MOST COST EFFECTIVE DESIGN FOR NEW INFRASTRUCTURE, AS WELL AS, INCREASING THE VALUE OF EXISTING INFRASTRUCTURE THROUGH THE APPLICATION OF AIRBORNE LIDAR AND LEADING SOFTWARE SOLUTIONS IN THOSE INDUSTRIES



THANK YOU



BY
GROUND DATA SOLUTIONS R&D SDN BHD

