

Saldanha Bay Water Quality Forum Trust

25 Oct 2019

Club Mykonos

Langebaan Road and Elandsfontein Aquifer Assessments

Dr Jaco Nel

Kezia Smith

Aqeela Parker

Ashleigh Tomlinson

Angelo Johnson

Involvement in Saldanha West Coast

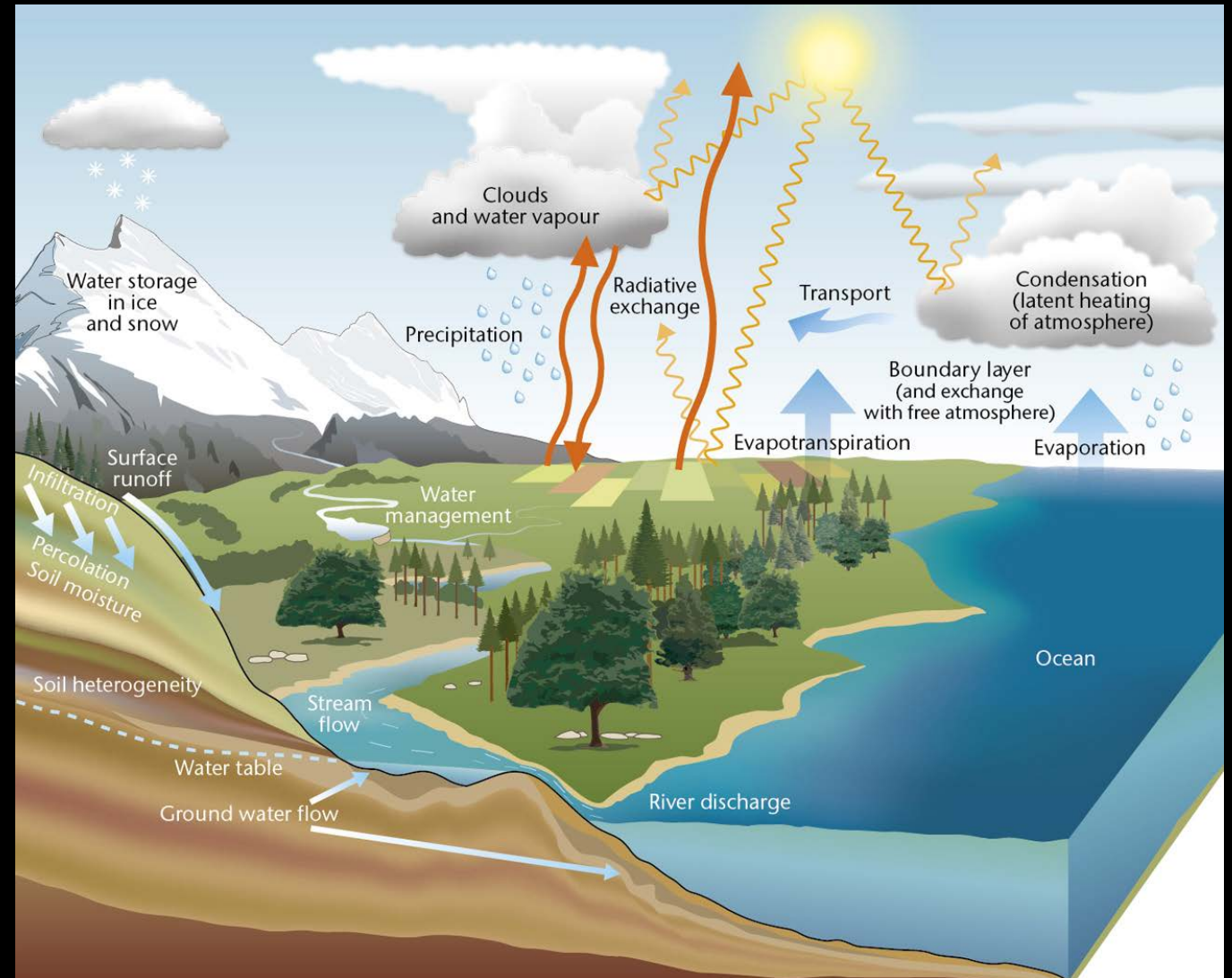
- 2015-2016 reviewer for SANParks to ensure no negative impacts from Elandsfontein Mine on WCNP or Langebaan Lagoon from a groundwater perspective.
- 2017 – Numerical model for water supply for SBM
- 2018-2019 – Numerical Models for Kropz using monitoring data to predict forward and improve management
- 2018 Langebaan Road Wellfield Expansion
- 2019 Hopefield wellfield development
- Currently
 - part of Elandsfontein and regional monitoring committees
 - Research and monitoring for SBM on wellfields and improved management.
 - Supervising a SANParks Junior Scientist doing a PhD on Sustainable Mine Closure – using Elandsfontein as one of case studies
 - Supervising 3 MSc students working on different aspects of the aquifer management
 - Continuous model updates for Kropz and SBM – integrated model.

Show do we solve the Water Balance ?

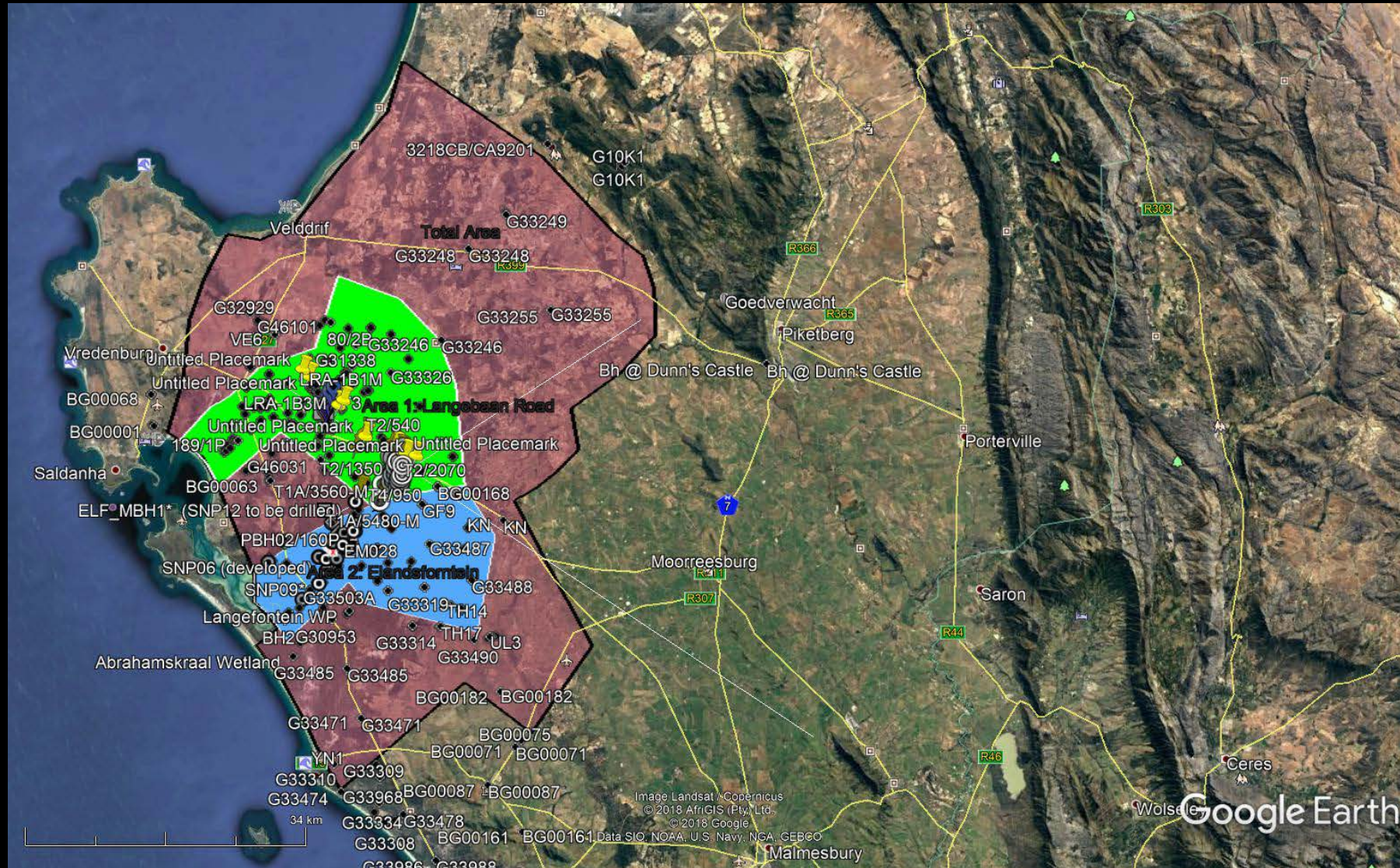
How much Recharge? – What flow path? – How many users? – What volumes? – discharge to lagoon, springs,

What real data do we have?

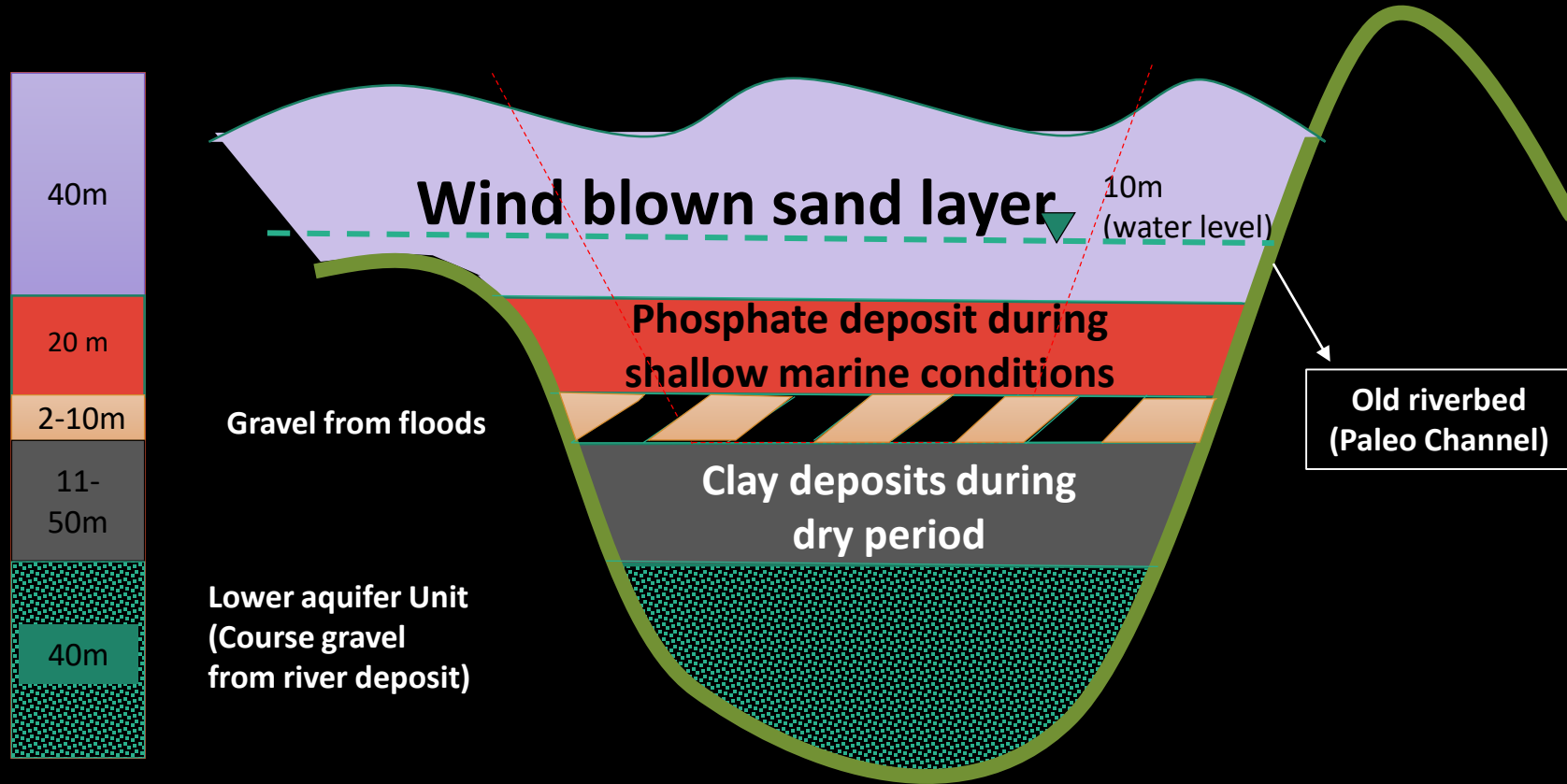
Where do each piece of the puzzle fit?



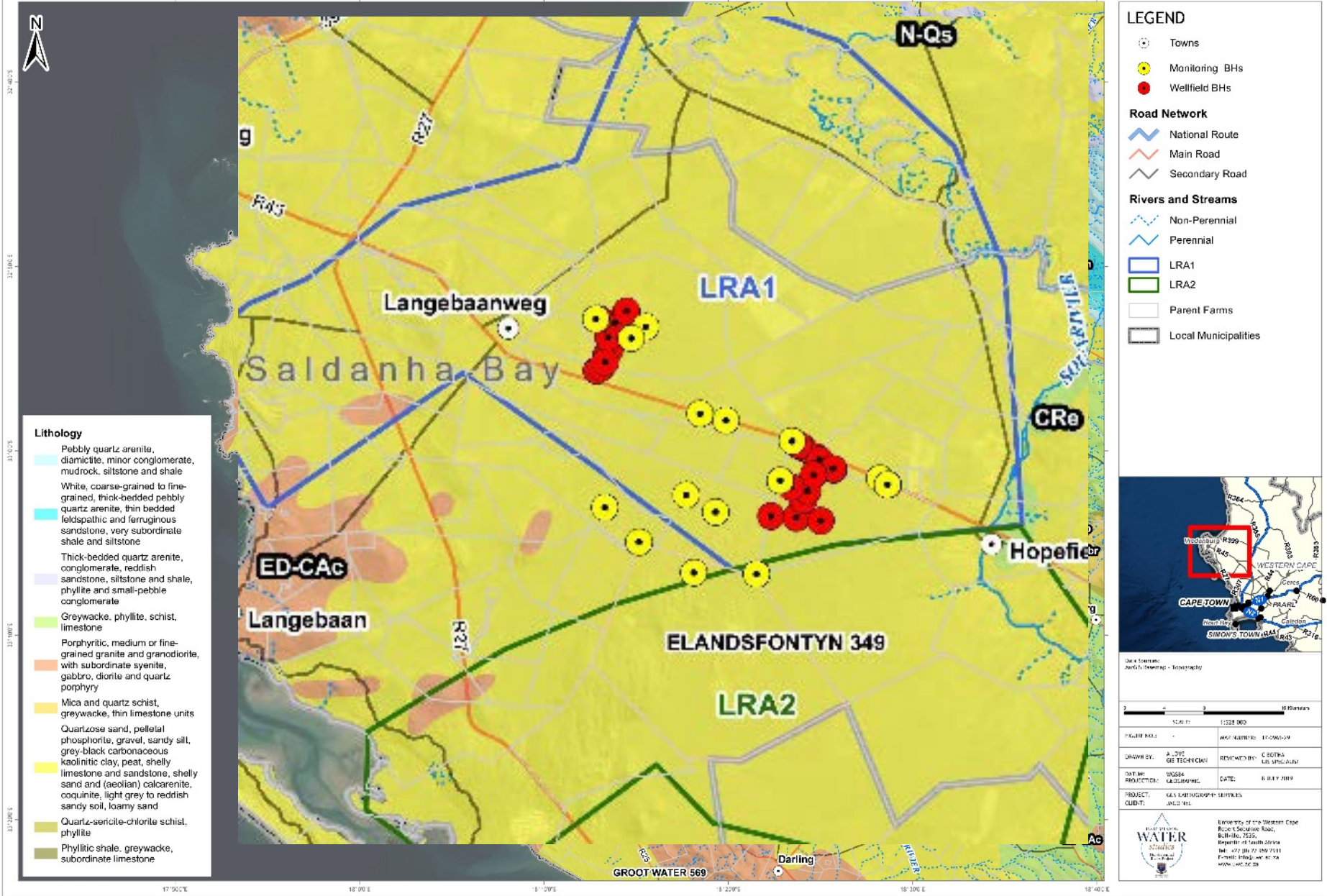
Study Area



Conceptual Cross Section



GEOLOGY: SBM RECHARGE STUDY



22°40'25" S
17°50'00" E
22°30'00" E
22°10'00" S
22°00'00" S
17°50'00" E
18°00'00" E
18°10'00" E
18°20'00" E
18°30'00" E
18°40'00" E

- Lithology**
- Pebbly quartz arenite, diamictite, minor conglomerate, mudrock, siltstone and shale
 - White, coarse-grained to fine-grained, thick-bedded pebbly quartz arenite, thin bedded feldspathic and ferruginous sandstone, very subordinate shale and siltstone
 - Thick-bedded quartz arenite, conglomerate, reddish sandstone, siltstone and shale, phyllite and small-pebble conglomerate
 - Greywacke, phyllite, schist, limestone
 - Porphyritic, medium or fine-grained granite and granodiorite, with subordinate syenite, gabbro, diorite and quartz porphyry
 - Mica and quartz schist, greywacke, thin limestone units
 - Quartzose sand, pelletal phosphonite, gravel, sandy silt, grey-black carbonaceous kaolinic clay, peat, shelly limestone and sandstone, shelly sand and (aeolian) calcarenite, coquina, light grey to reddish sandy soil, loamy sand
 - Quartz-sericite-chlorite schist, phyllite
 - Phyllitic shale, greywacke, subordinate limestone

- LEGEND**
- Towns
 - Monitoring BHs
 - Wellfield BHs
- Road Network**
- National Route
 - Main Road
 - Secondary Road
- Rivers and Streams**
- Non-Perennial
 - Perennial
- LRAs**
- LRA1
 - LRA2
- Parent Farms**
- Parent Farms
- Local Municipalities**
- Local Municipalities



Scale: 1:228 000

PROJECT NO:	WSP/2008/01	REVISION:	EP0005-04
DRAWN BY:	A. JONES	REVIEWED BY:	C. BOTHA
PROJECTOR:	GEOTECHNIQ	DATE:	05 JULY 2009

DATE: 10/08/04
PROJECTOR: GEOTECHNIQ
DATE: 05 JULY 2009

PROJECT: GWS LITHOLOGY SERVICES
CLIENT: JACO WIL

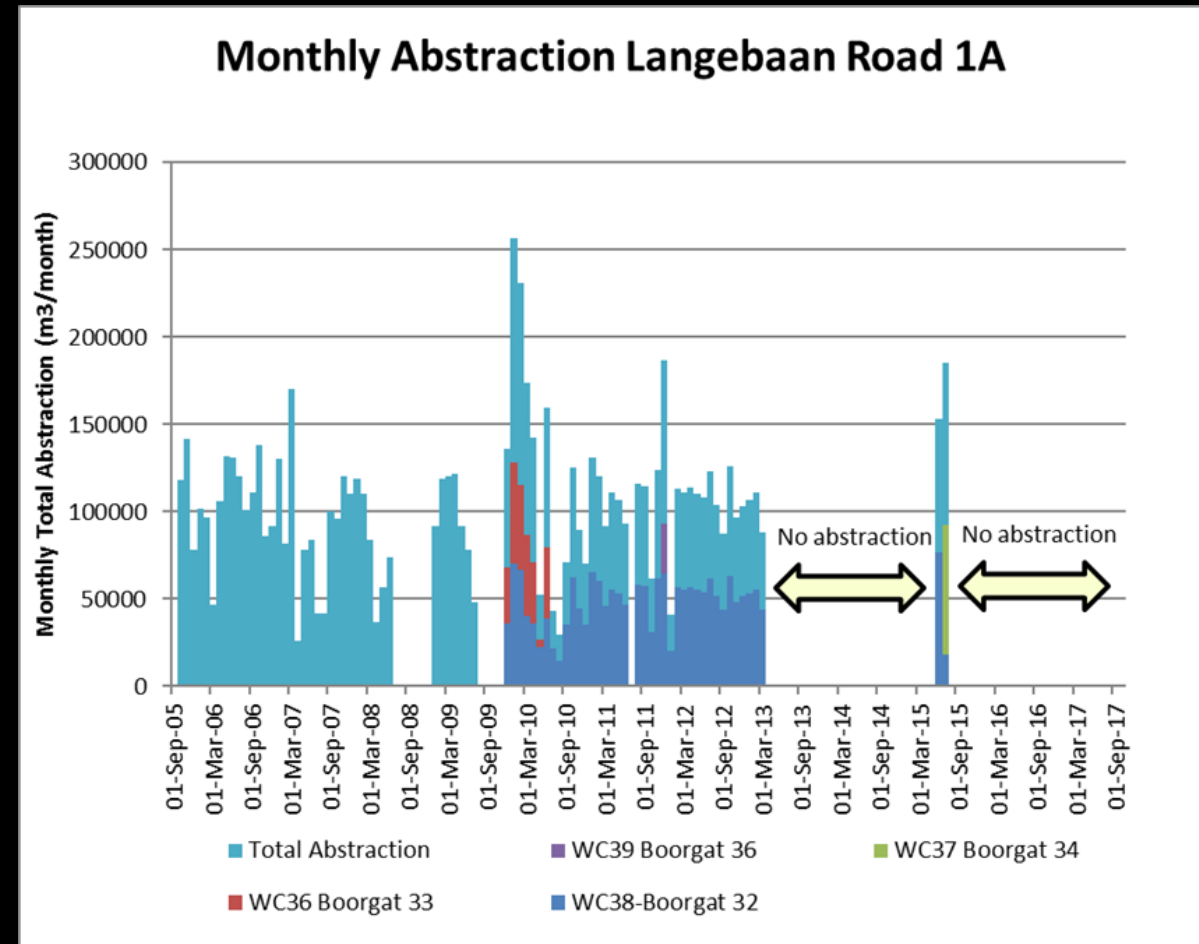
WATER STUDIES

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Langebanaan

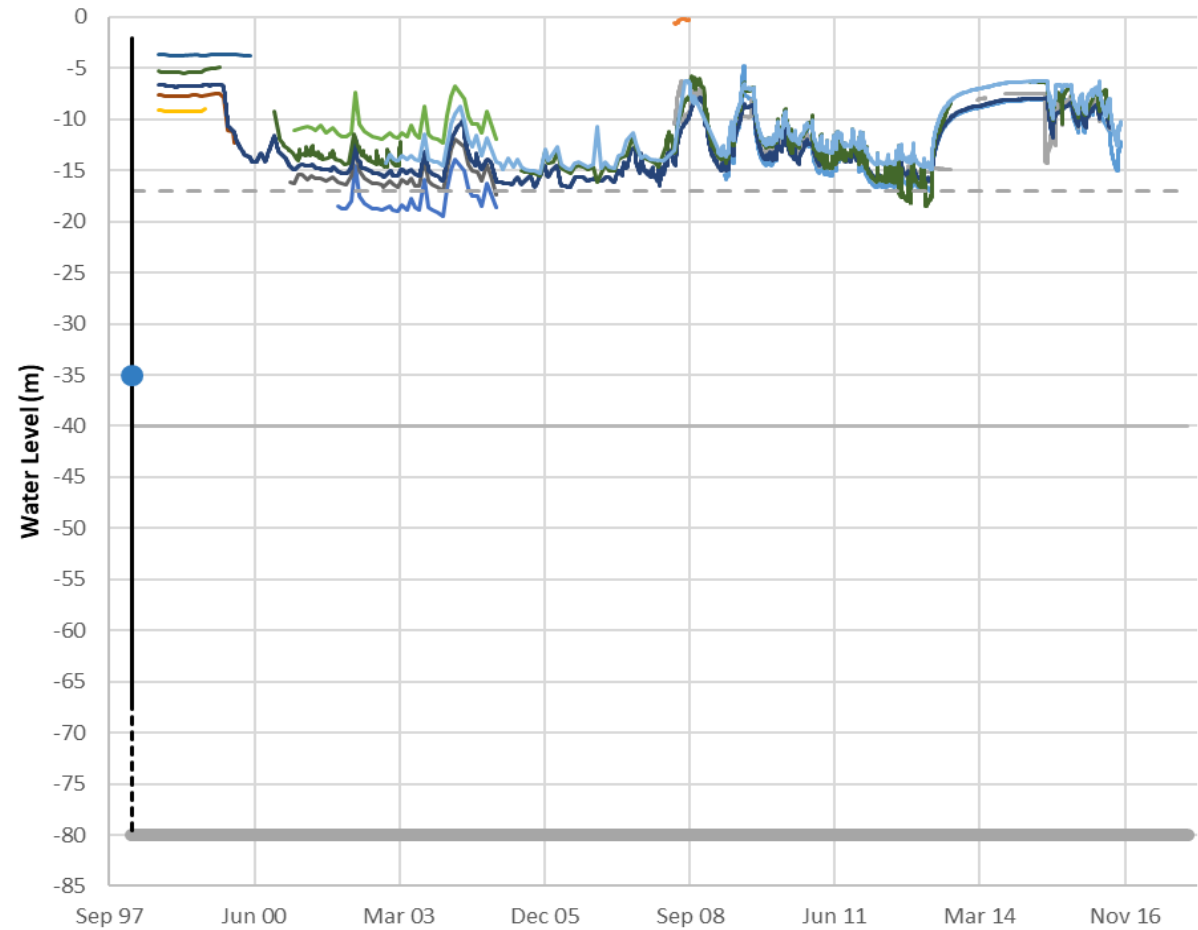
Wellfields

- Langebaan Road 1A – 4 Production Wells
- Langebaan Phase 2 – 4 Additional Wells in lower aquifer
- Hopefield – 10 Additional Wells in upper aquifer



Old Water Levels

Water Levels at Langebaan Road 1A Wellfield

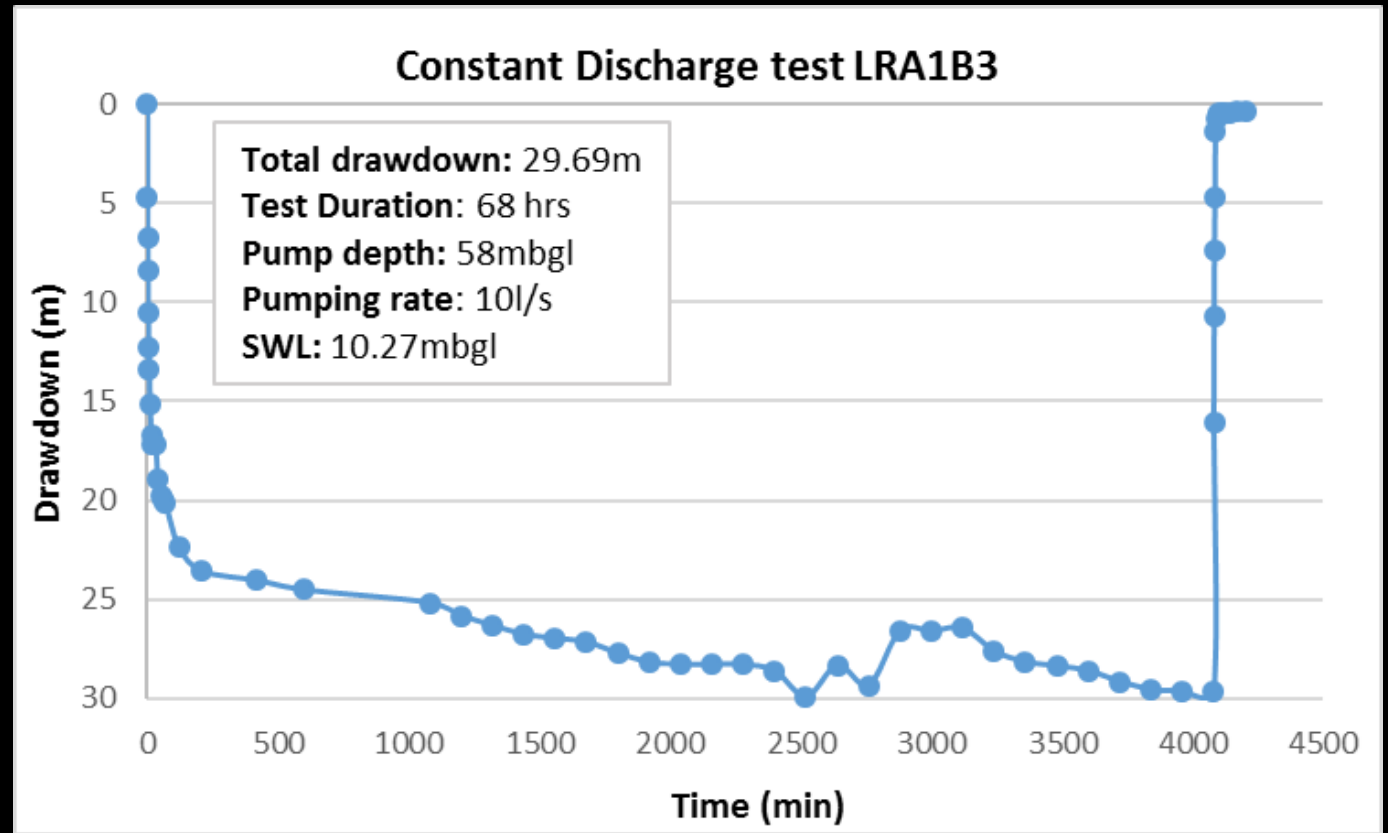


- BG136
- G45632
- G1N0339
- G45634B
- G46105
- Bottom of LR 1A Wellfield
- Pump inlet
- BG137
- G45632A
- G45634A
- G45635A
- Bottom of Aquitard
- Solid
- G45633A
- G45634A
- G45636
- Top of Aquitard
- Screen

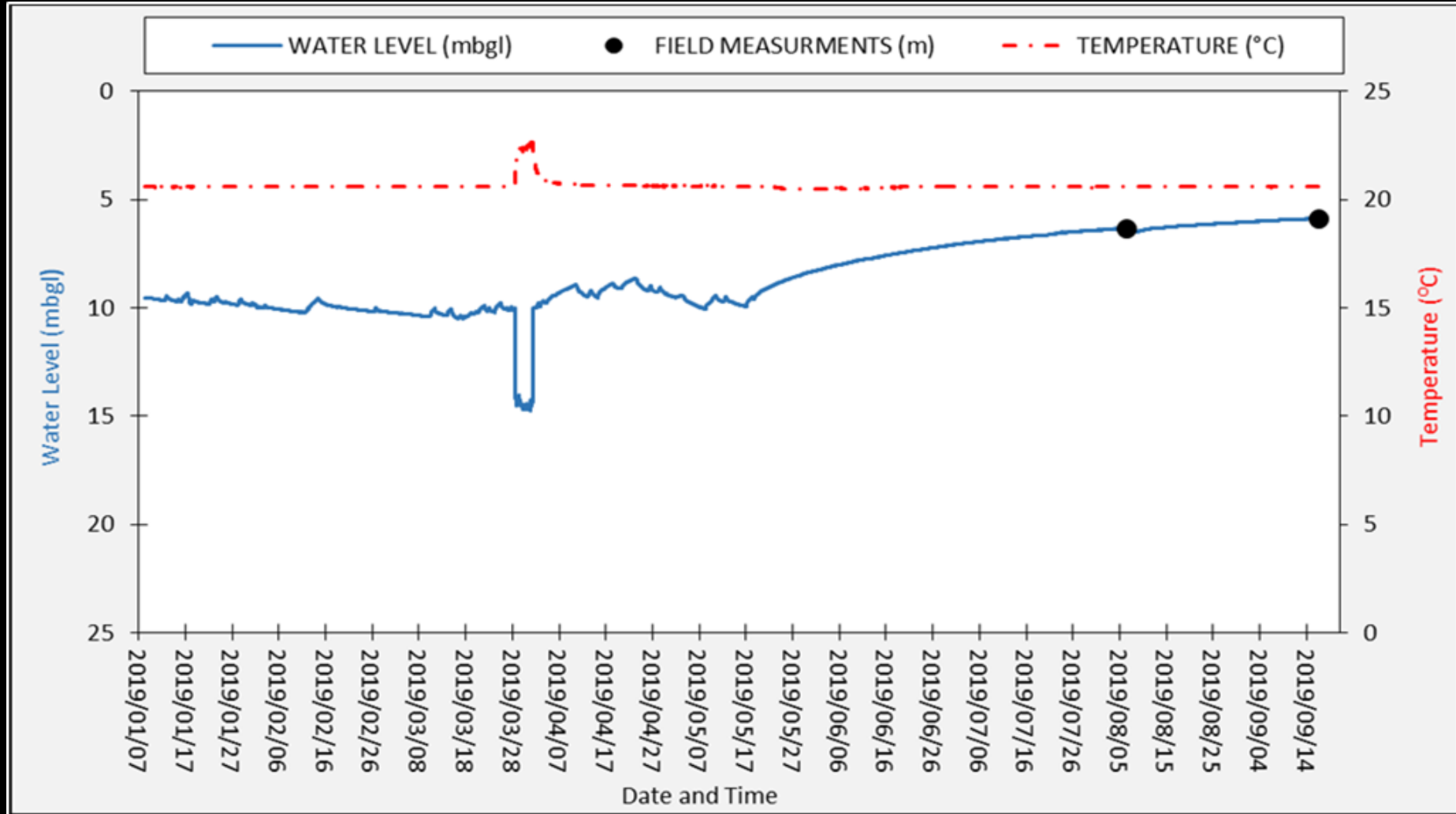
New Boreholes and testing

Borehole log :Production Borehole 3 (LRA 1B-PBH3)
 Date:27 February 2018 Drill method: Mud Rotary
 Location:Langebaan Road Elevation:38m
 Latitude:-32.967917° Groundwater Level: 10.25m
 Longitude:18.196432°

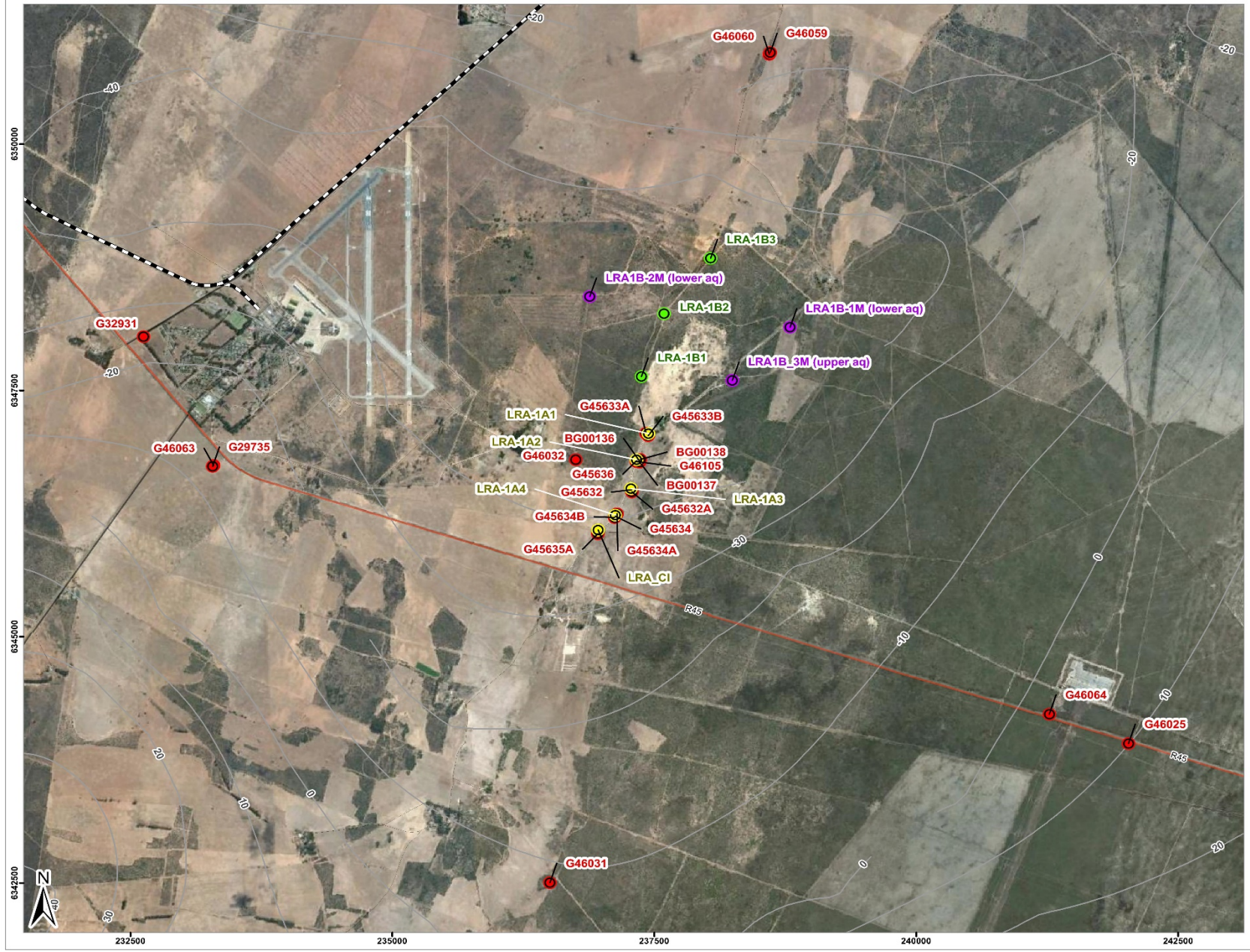
Lithological Description	Lithology	Depth (m)	Borehole Construction	Borehole Description
Upper Aquifer White and orange calcrete		0		Gravel Pack
Aquitard Light grey clay		10		Water Level 10.25m
Well sorted fined grained quartzitic sands		20		uPVC solid casing (315mm)
Dark peaty clay with mixed with small amounts of fine quartzitic sands		40		
Lower Aquifer Well sorted fined grained quartzitic sands.		50		Bentonite Seal
Medium, grained quartzitic sands		60		uPVC slotted casing (315mm)
Light grey clay with small mixture of quartzitic sands		70		Backfill
		80		



Langebaan Road Monitoring – New Borehole LRA1B1



LANGEBAAN ROAD WELLFIELD 1B: MONITORING BOREHOLES



LEGEND

- Existing Production Boreholes
- Proposed Production Boreholes
- Proposed New Monitoring Boreholes
- Existing DWS Monitoring Boreholes

Road Network

- National Route
- Main Road
- Secondary Road
- Street
- Railway Line

Rivers and Streams

- Non-Perennial
- Perennial
- 10m Contours



Data Sources:
 Google Earth™ mapping service: 2018
 Imagery Date: 19/05/2017

SCALE: 1:35 000	
FIGURE NO.: -	MAP NUMBER: 17-0946-75-V2
DRAWN BY: AMT ANHWRANAZI GIS INTERN	REVIEWED BY: P. CHETTY GIS SPECIALIST
DATUM: WGS84 PROJECTION: UTM34S	DATE: 12 FEBRUARY 2018
PROJECT: GCS CARTOGRAPHY SERVICES	
CLIENT: JACO NEL	

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Hopefield

Cenozoic Strata Thickness

(Roberts and Siegfried 2014)

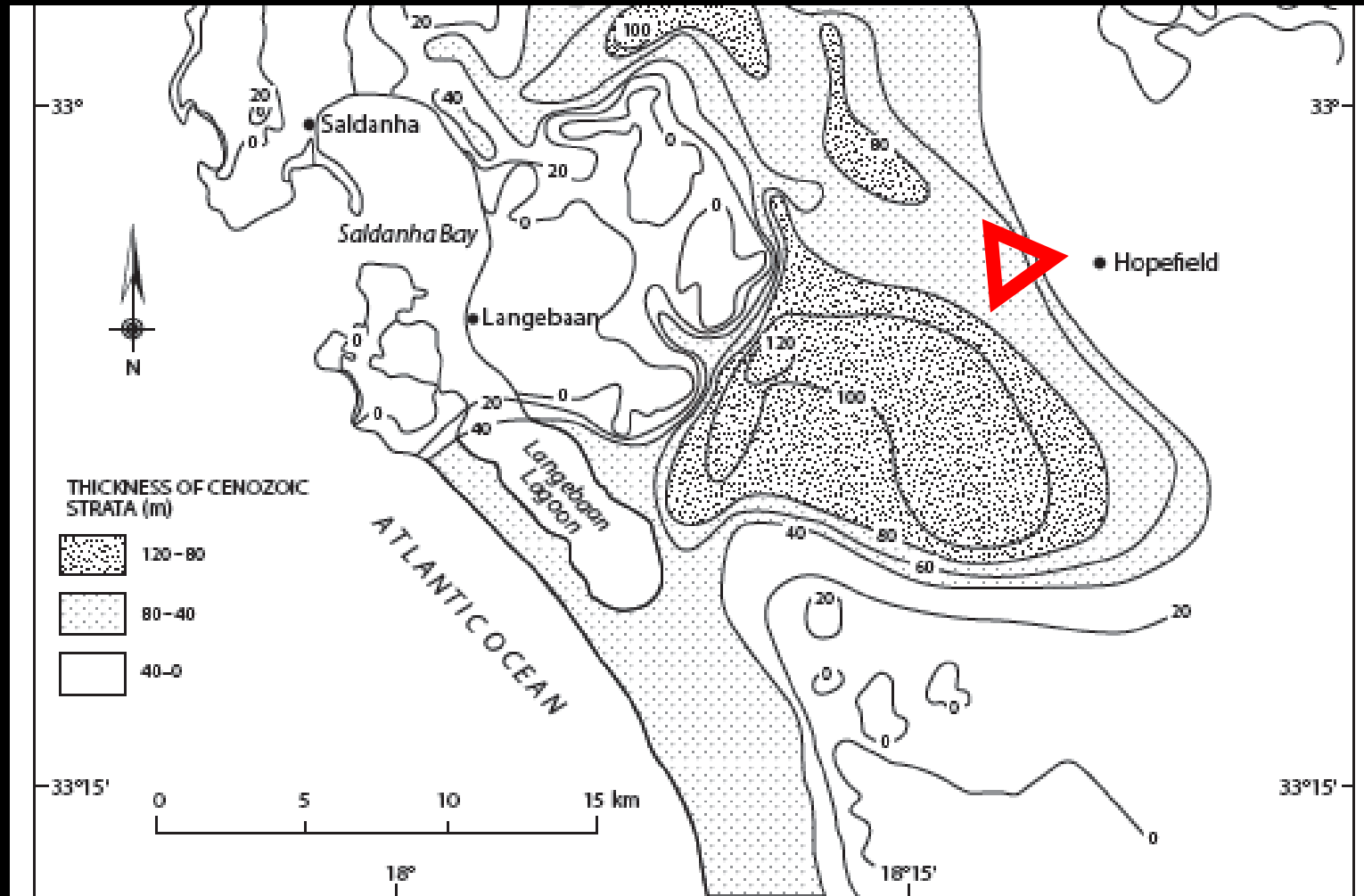
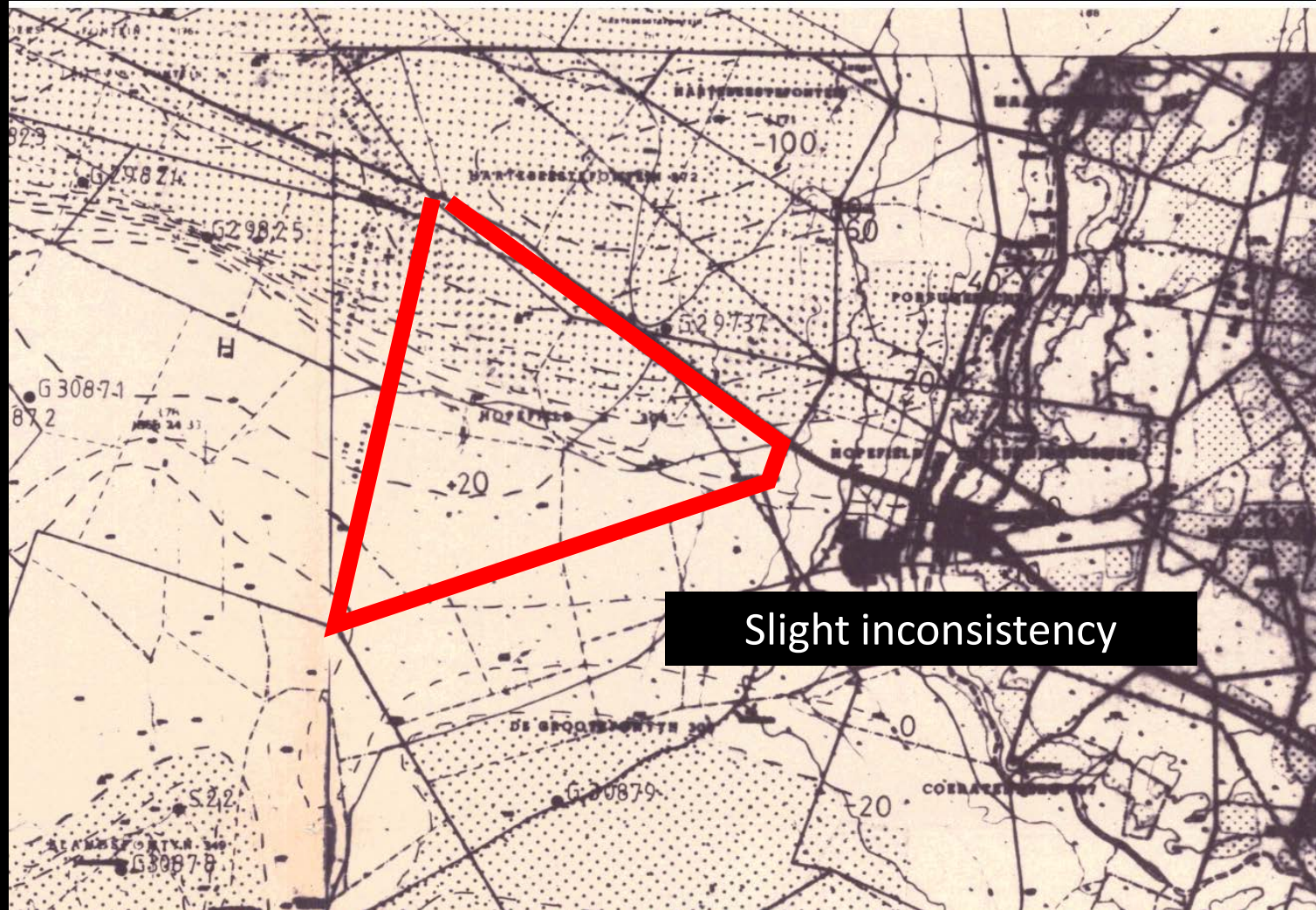


Fig. 4.2 – Isopachs of Cenozoic strata in the Saldanha, Vredenburg and Veldrif environs. The depocentres record the locations of ancient channels of the Berg River and possibly the Groen River in the east.

Geo-Electric Basement (Smith 1982)

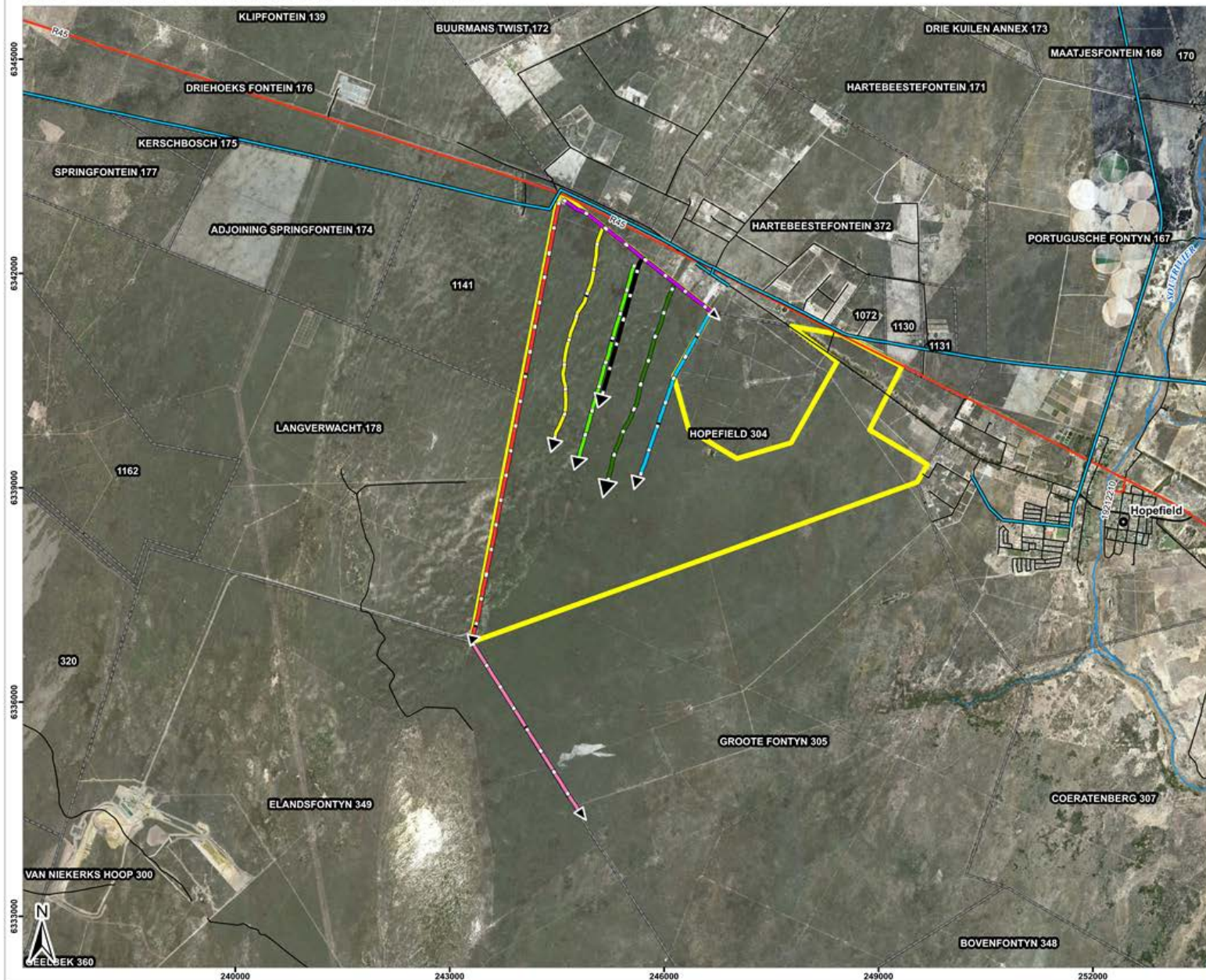




Flow pat

- Very much a
- Assumptions

HOPEFIELD: GEOPHYSICS - LOCALITY



LEGEND

- Town
- Geophysical Traverses**
 - ↔ Traverse Line 1A
 - ↔ Traverse Line 1B
 - ↔ Traverse Line 2
 - ↔ Traverse Line 3
 - ↔ Traverse Line 4
 - ↔ Traverse Line Ha
 - ↔ Traverse Line Hb
 - ↔ Traverse Line Ho3R
 - ↔ Western Cape District Pipelines
- Road Network**
 - ↔ National Route
 - ↔ Main Road
 - ↔ Secondary Road
 - ↔ Street
- Rivers and Streams**
 - ↔ Non-Perennial
 - ↔ Perennial
- ▭ Parent Farms
- ▭ Property Boundary



Data Sources:
 Google Earth™ mapping service: 2019
 Imagery Date: 27/09/2017

SCALE: 1:50 000

FIGURE NO.: - MAP NUMBER: 17-096-26-V3

DRAWN BY: AMT MOKHNAZI GIS TECHNICIAN REVIEWED BY: P CHETTY GIS SPECIALIST

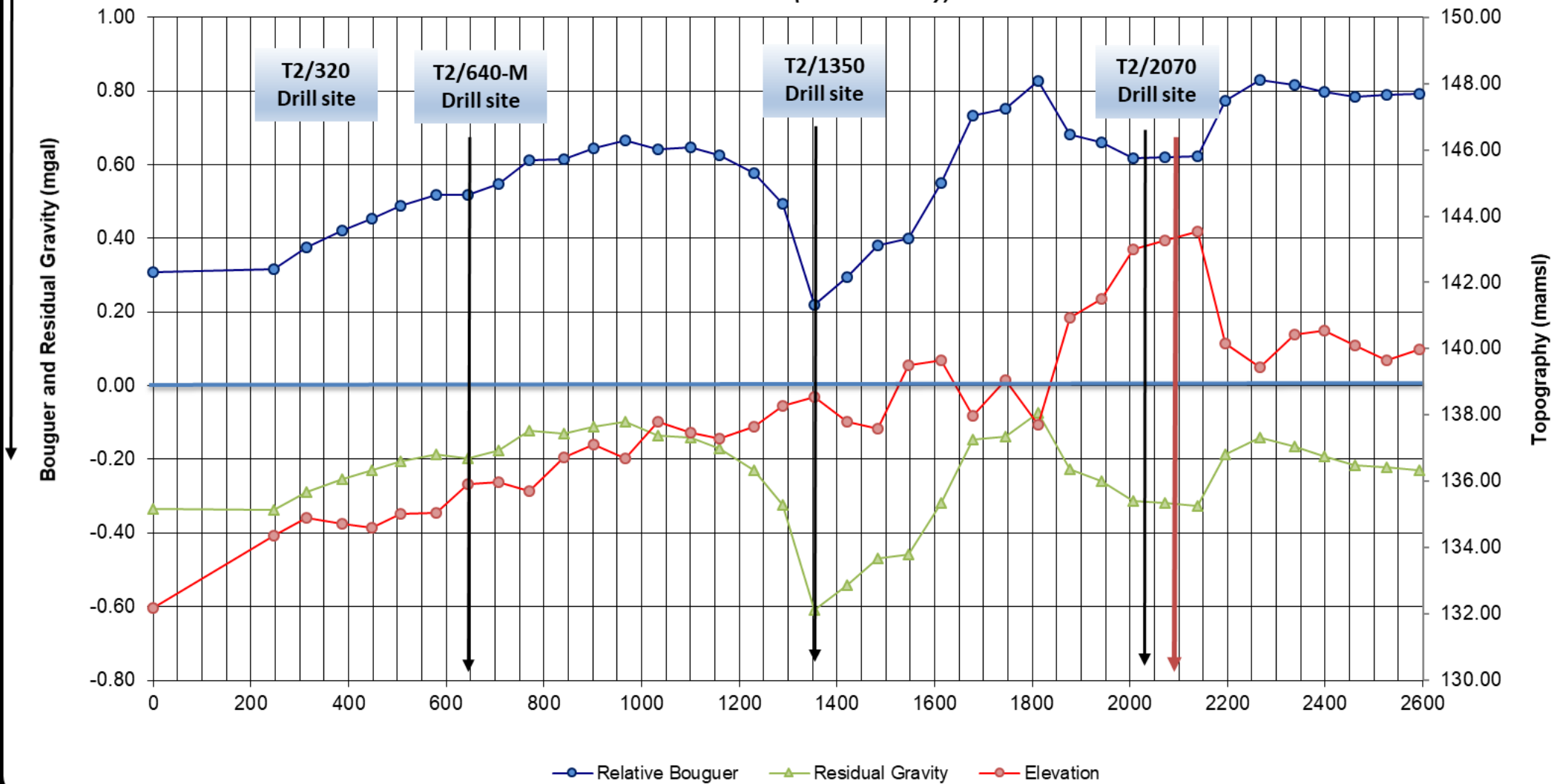
DATUM: WGS84 PROJECTION: UTM36S DATE: 11 MARCH 2019

PROJECT: GCS CARTOGRAPHY SERVICES CLIENT: JACO NEL



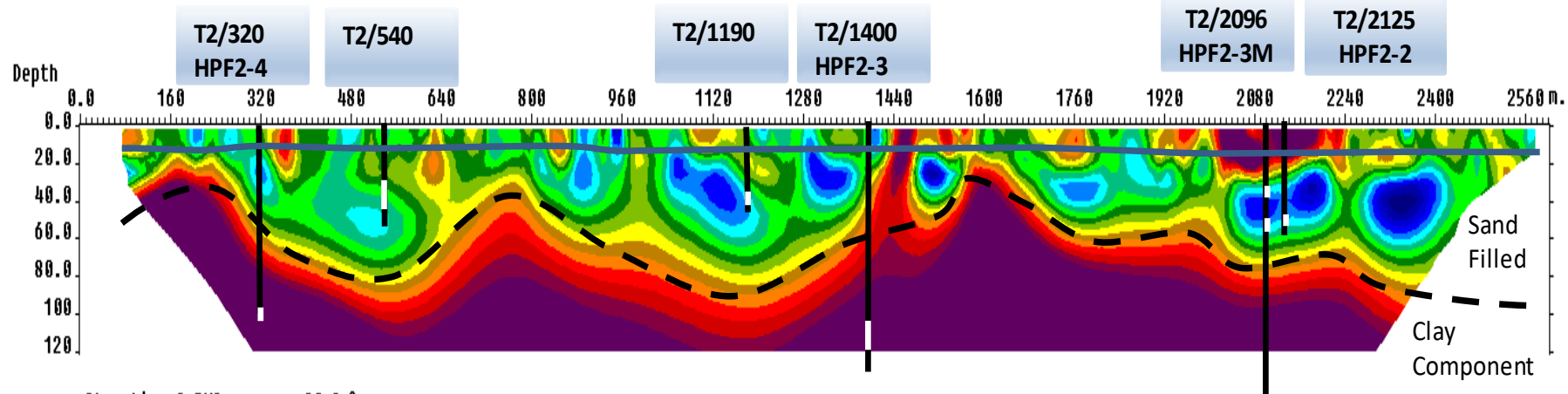
HOPEFIELD

Traverse 2 (Line 5 - Gravity)



HOPEFIELD

Traverse 2

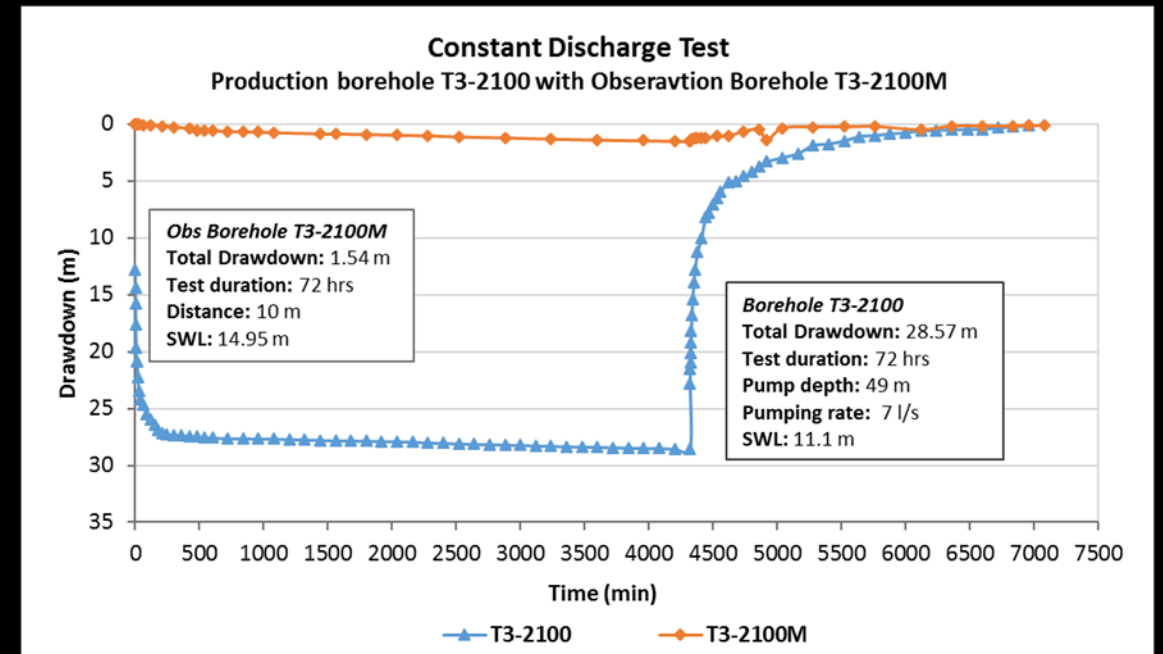
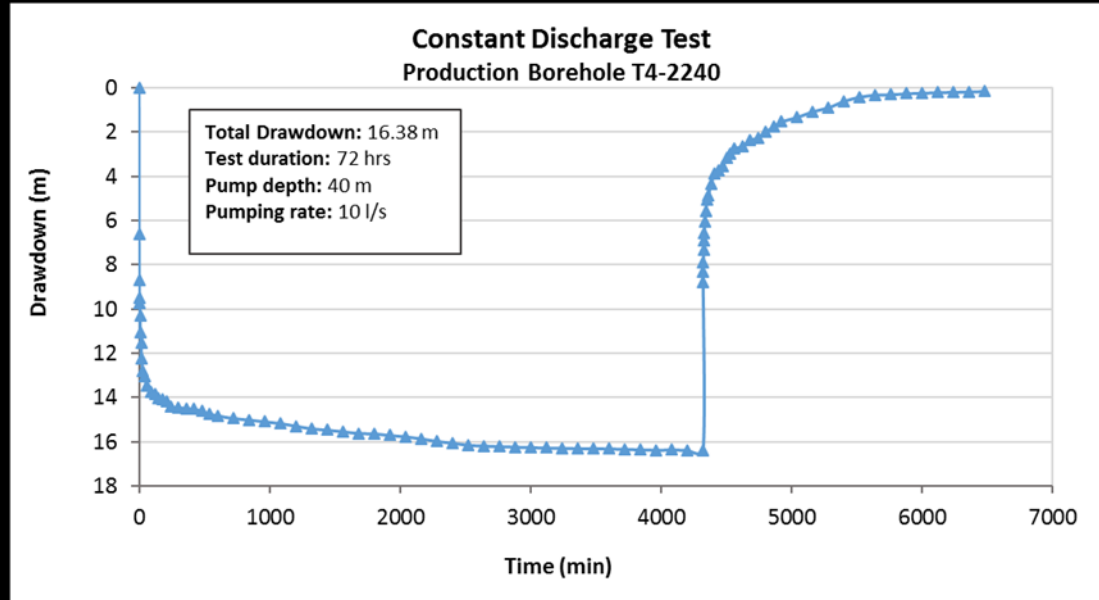


Iteration 3 RMS error = 20.3 %

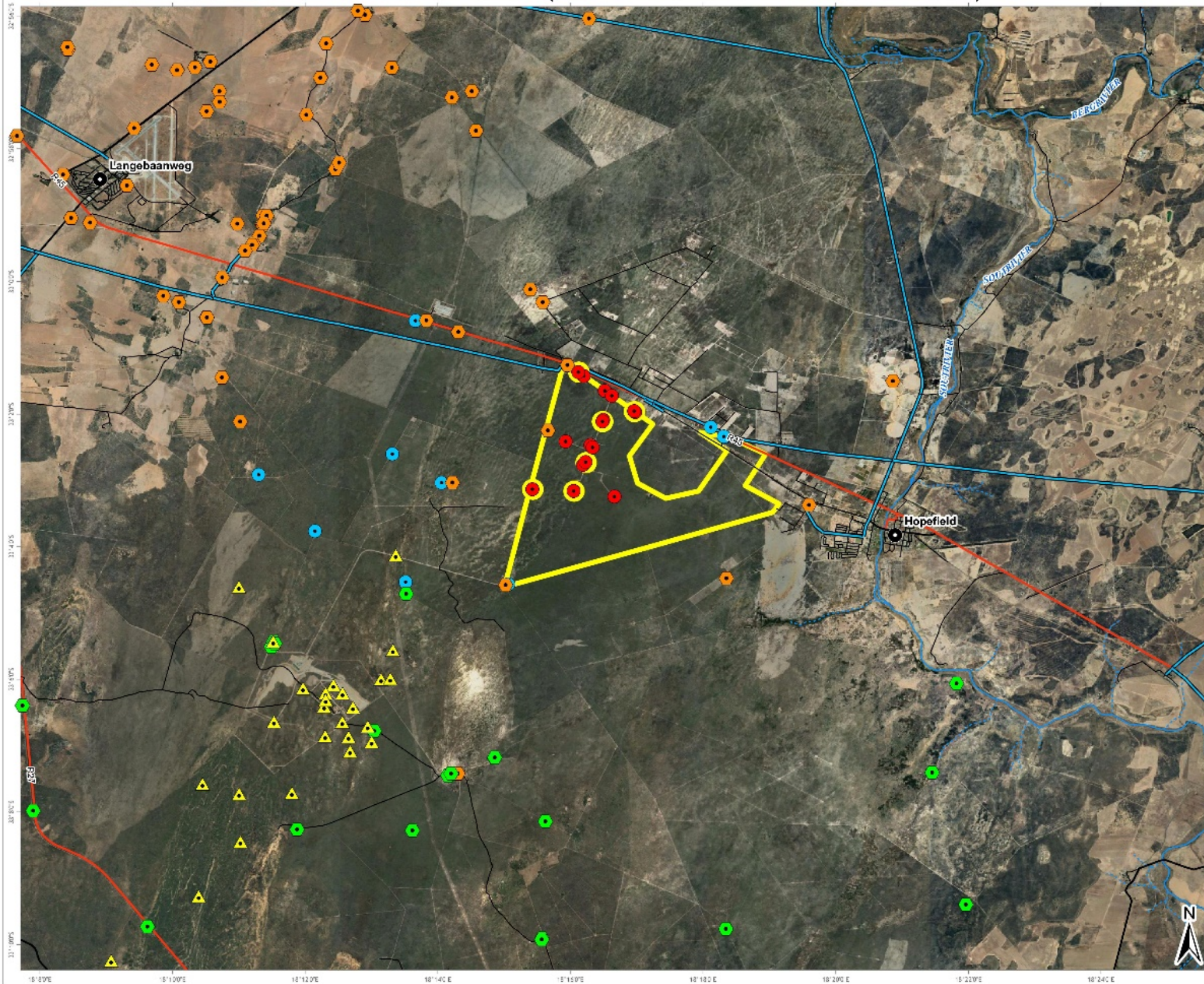


Hopefield

Aquifer tests conducted – no pumping yet



HOPEFIELD: GROUNDWATER MONITORING (ELANDSFONTEIN AND LANGEBAAN)



- LEGEND**
- ▲ EMF Monitoring Boreholes
 - DWS Boreholes
 - NGA Boreholes
 - Town
 - Monitoring and Production Boreholes (with dataloggers)
- Geosite Boreholes**
- Elandsfontein
 - Langebaan
- Western Cape District Pipelines**
- Western Cape District Pipelines
- Road Network**
- National Route
 - Main Road
 - Secondary Road
 - Street
- Rivers and Streams**
- Non-Perennial
 - Perennial
 - Property Boundary



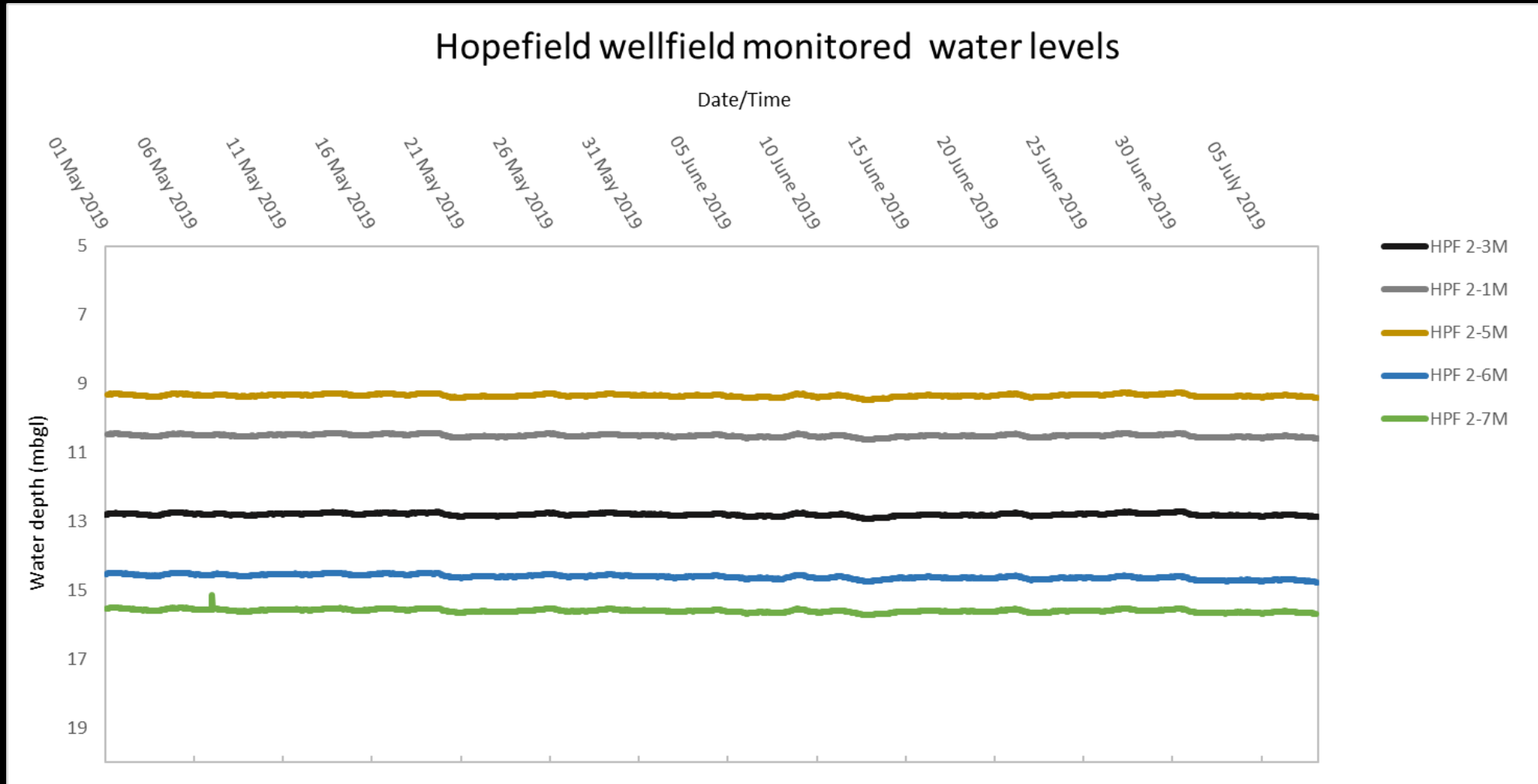
Data Source: Google Earth™ imagery version: 2011
 Imagery Date: 12/07/2011



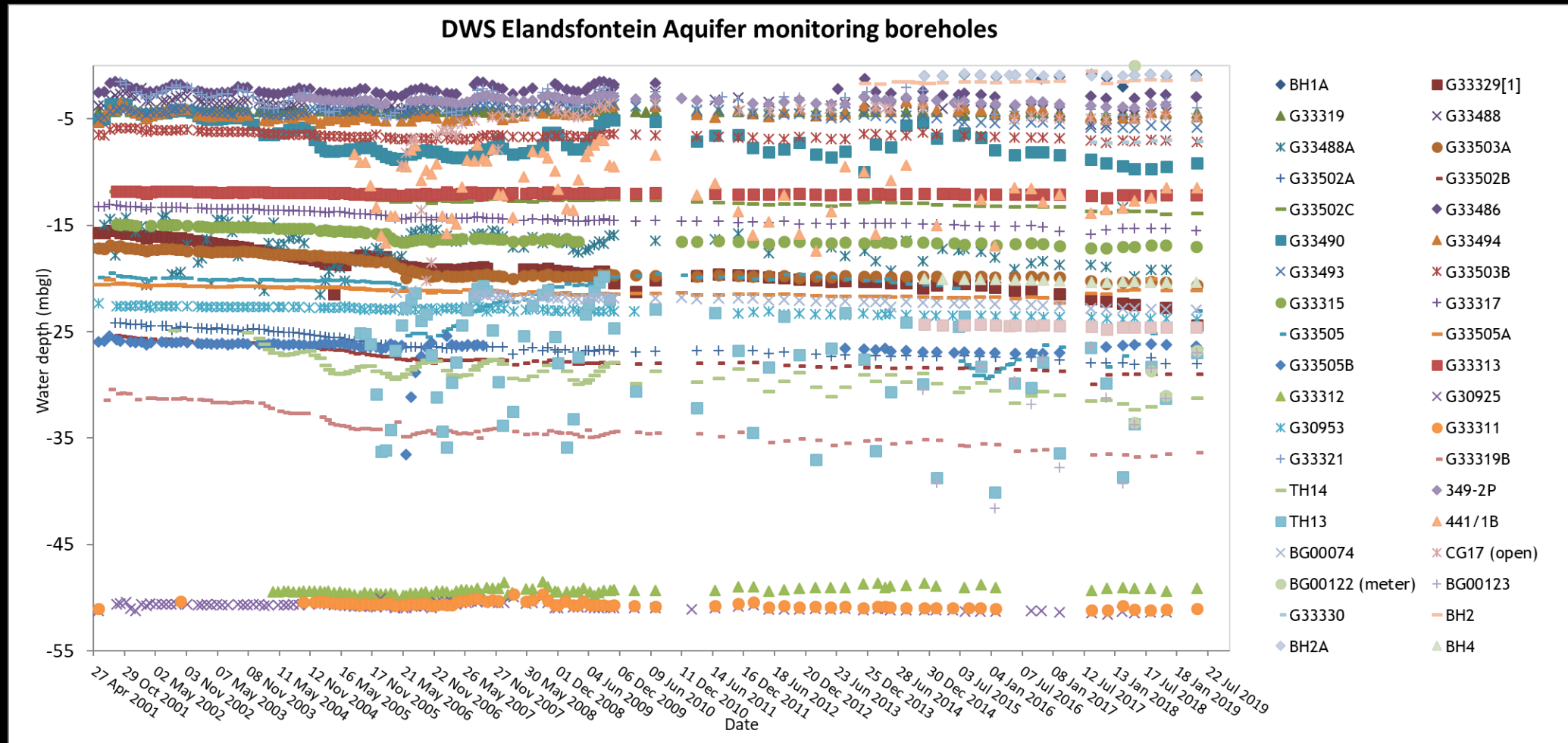
FIGURE NO:	2011-07-01	FIGURE NO:	170001-04
DRAWN BY:	N. NABOO	DATE DRAWN:	17/07/2011
DESIGNED BY:	G. S. S. S. S.	DATE DESIGNED:	17/07/2011
DATE:	17/07/2011	DATE:	17/07/2011
PROJECT:	GCS CARTOGRAPHY SERVICES		
CLIENT:	JMSD WEL		

GCS CARTOGRAPHY SERVICES
 170001-04
 17/07/2011
 17/07/2011
 17/07/2011
 17/07/2011

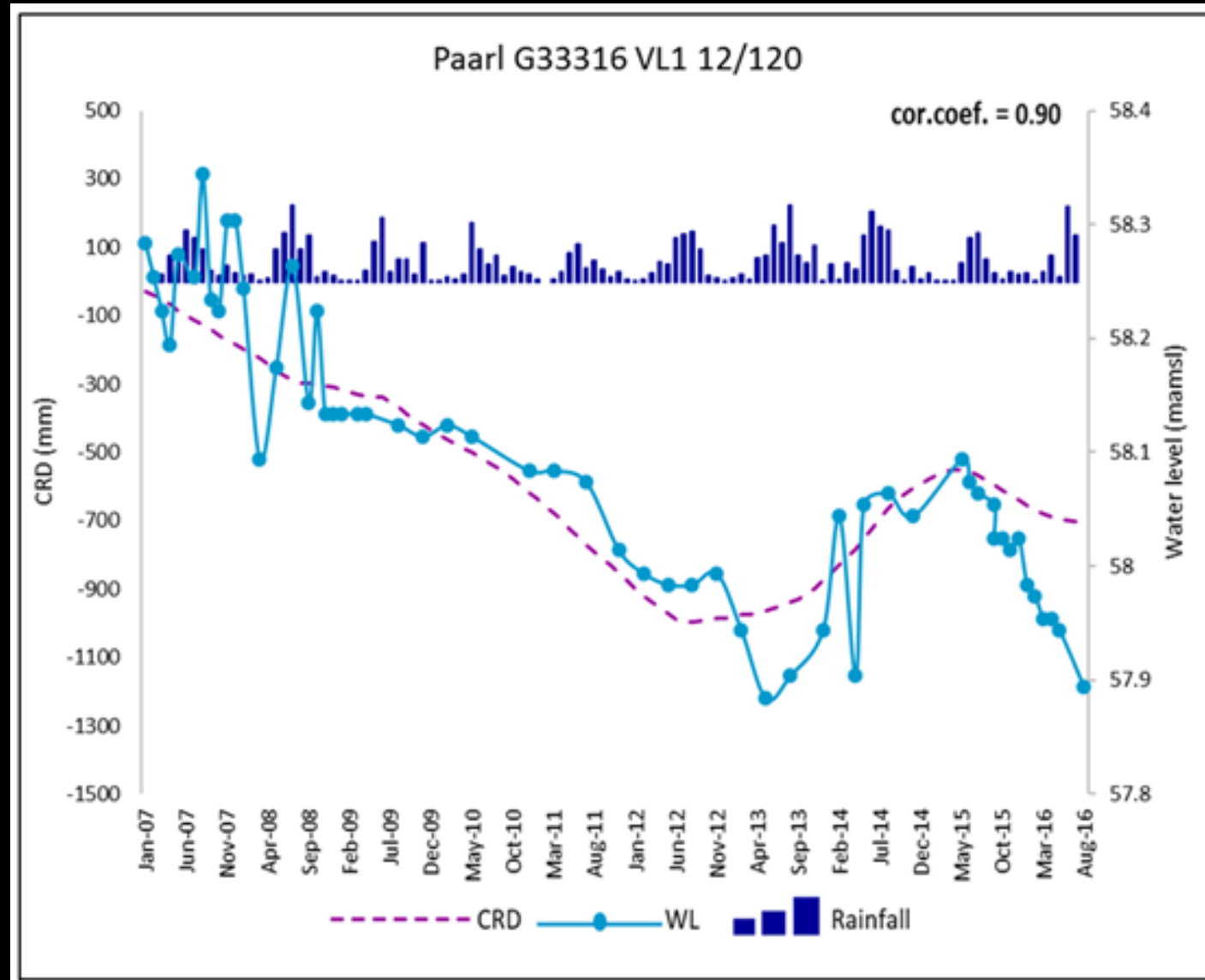
Hopefield Monitoring



DWS Monitoring frequency not optimal for wellfield management



Example From Kezia MSc



Discharge

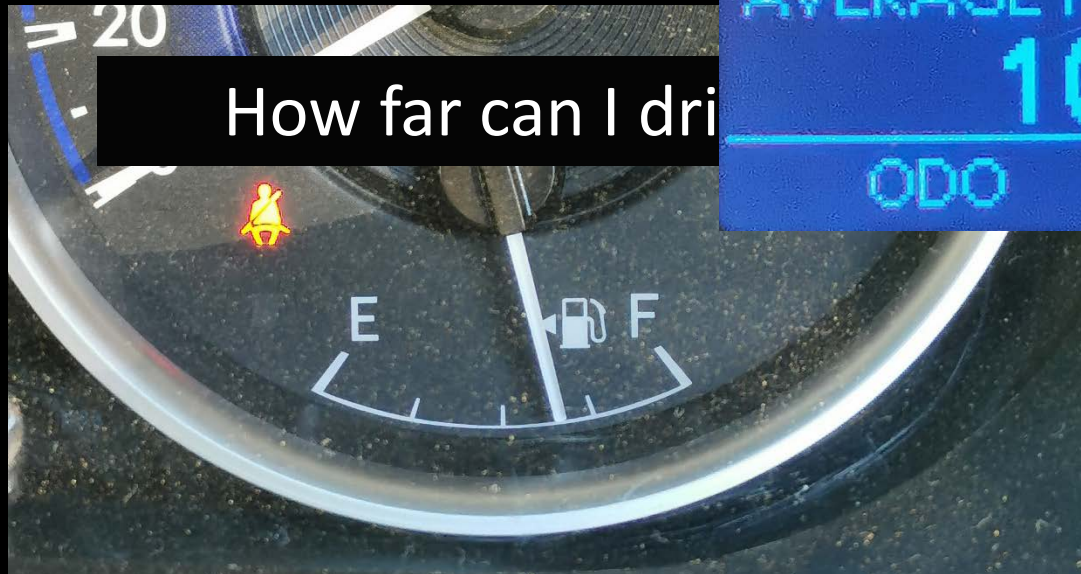
- Reeds at Geelbek
- Volumes?
- Exactly what is the local discharge process

- Push in Soil probe - Temperature and EC profiles
- Hope to get a vertical profile of salinity and zones of discharge.
- Will also try resistivity geophysical profiles – not sure we can get useful resolution with depth.

Numerical Models and Predictions

What do I use models for?

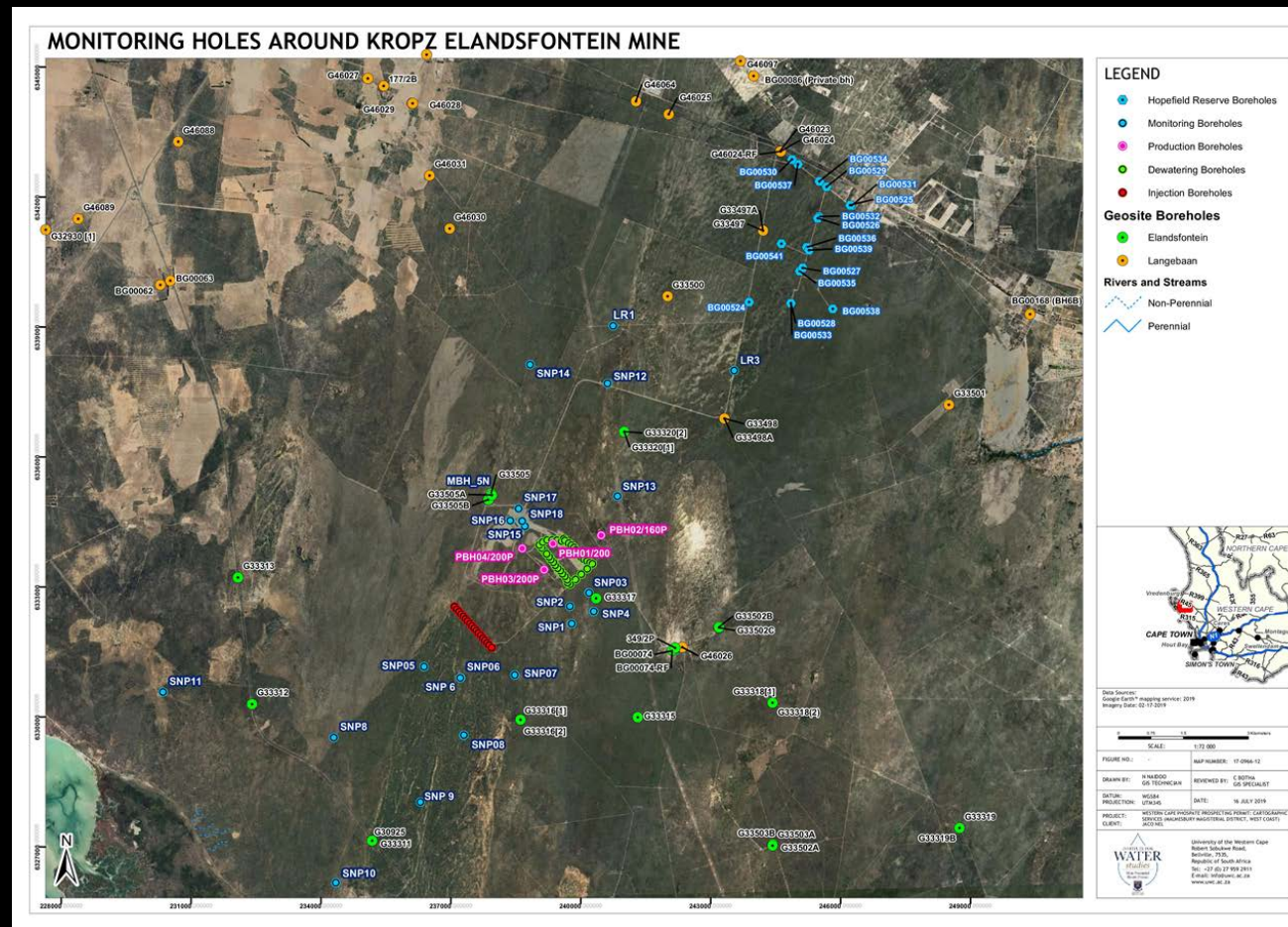
- Integrate all the kn



- Evaluate the data I have – perhaps make some assumption – use the data in a suitable equation - predict forward
- Uncertainty ?

Numerical model

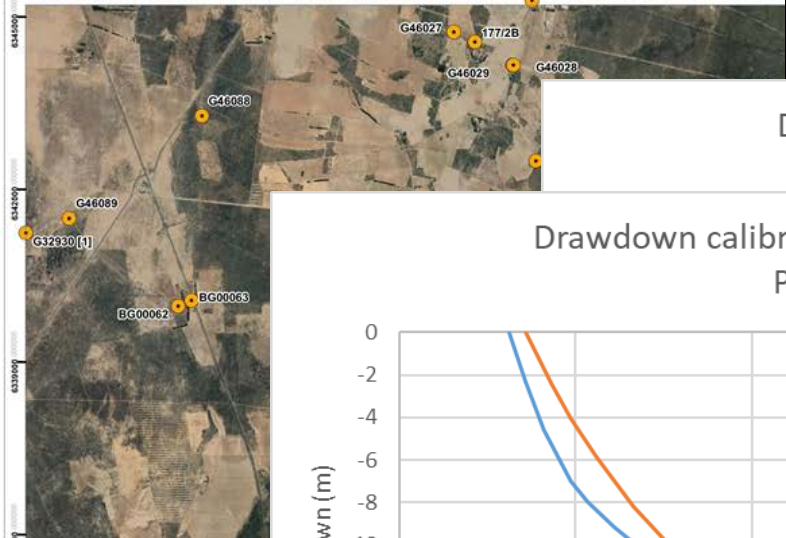
- One model partly funded by SBM and partly by Elandsfontein mine



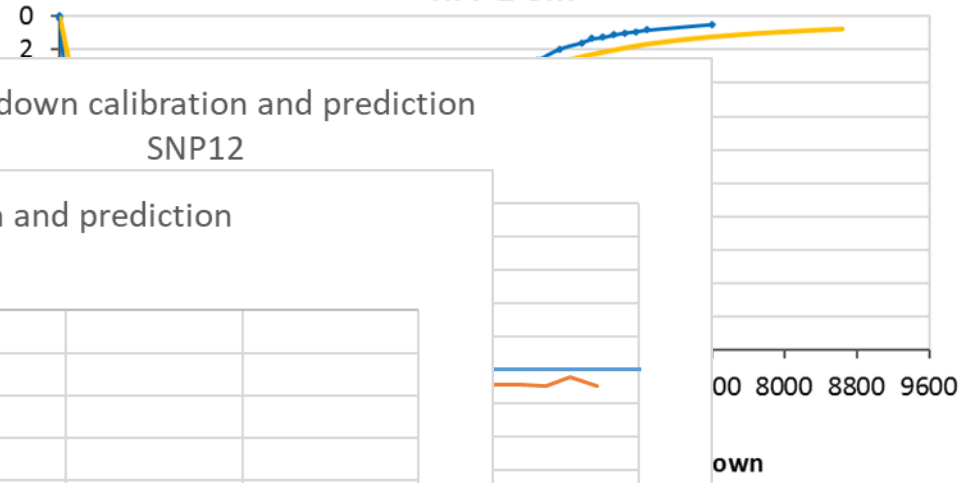
Number

- One mo

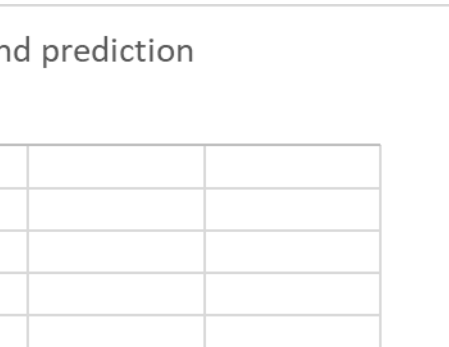
MONITORING HOLES AROUND KROPZ ELANDSFONTEIN



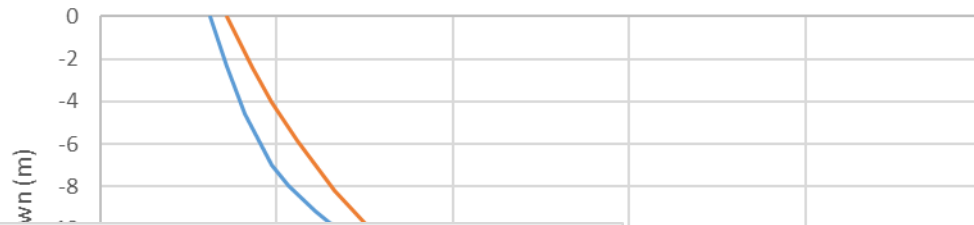
Drawdown calibration and prediction
HPF 2-3M



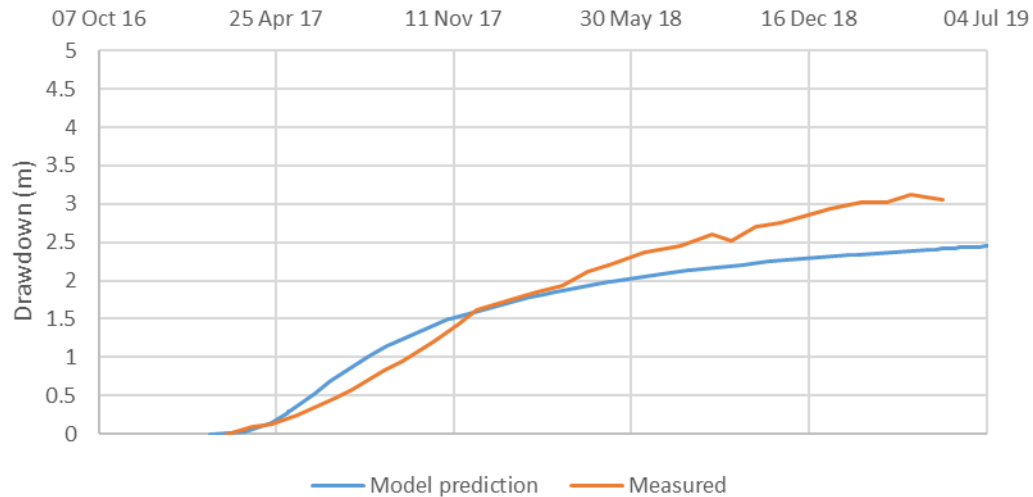
Drawdown calibration and prediction
SNP12



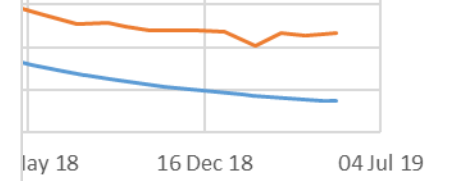
Drawdown calibration and prediction
PBH1



Drawdown calibration and prediction
SNP5



18 04 Jul 19



Measured



Data Sources:
Google Earth™ mapping service: 2019
Imagery Date: 02-17-2019

SCALE: 1:72 000

FIGURE NO.:	HAP NUMBER: 17-0966-12
DRAWN BY: N. N. KODD G.S. TECHNICIAN	REVIEWED BY: C. BOTHA G.S. SPECIALIST
DATUM: WGS84	DATE: 16 JULY 2019
PROJECTION: UTM34S	
PROJECT: WESTERN CAPE PROGRESSIVE INFRASTRUCTURE PERMIT (CARISGRANIC SERVICES) (MUNICIPALITY INDUSTRIAL DISTRICT, WEST COAST)	
CLIENT: JACO NEL	

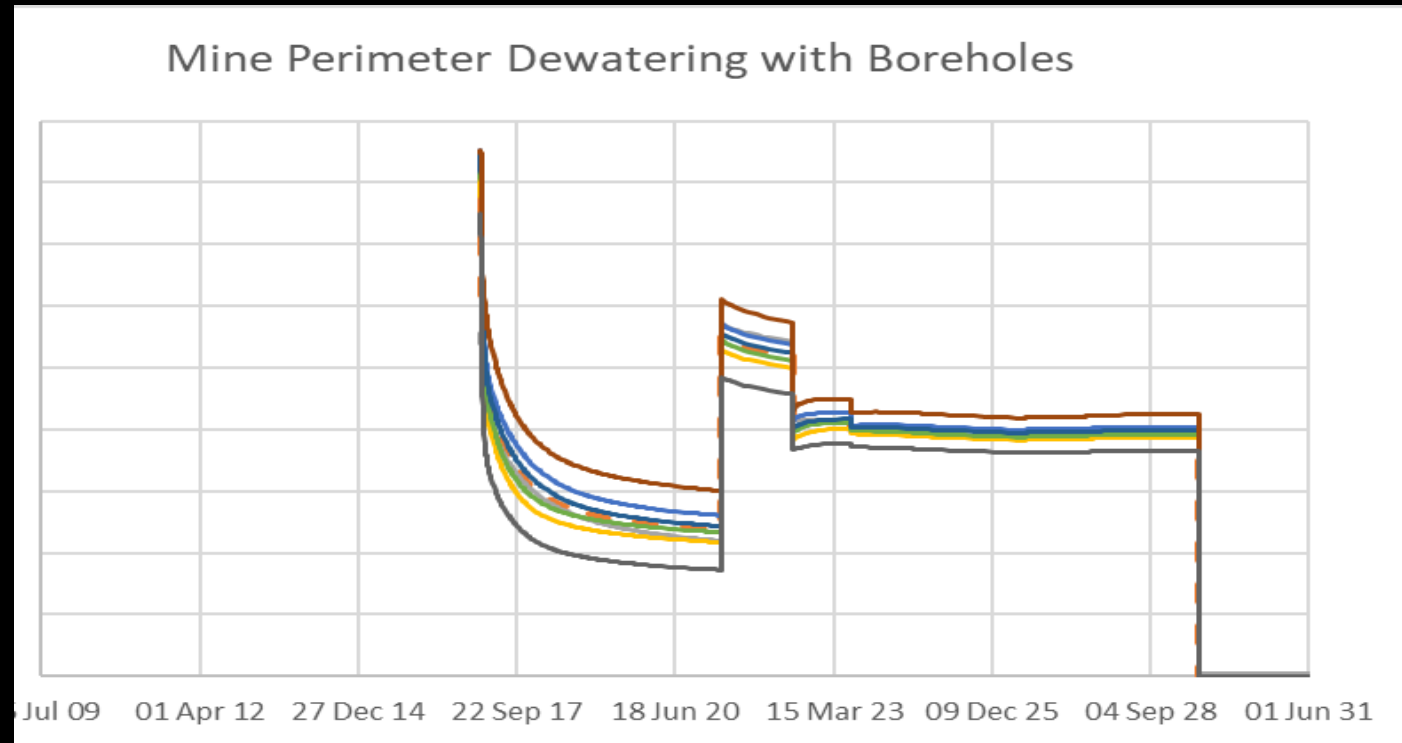
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Sensitivity Analysis and predictions

- Uncertainty in spatial distribution of sand layers, bedrock, rainfall
- Determine Effect of Uncertainty on Calibrated Model
- Lets Play – and see how the model behaves when we put it under stress



Predictions considering different management scenarios



Work currently being implemented

- Water balance and Cl balance
- Additional Rainfall samplers – Cl and Water isotopes
- Unsaturated zone Cl and Temperature – different plants will influence the Cl reaching the GW differently
- Saturated zone Cl and Temperature – identify different flow zones.

Thank You



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