Pathways from Land to Stream - Lessons from Pukemanga

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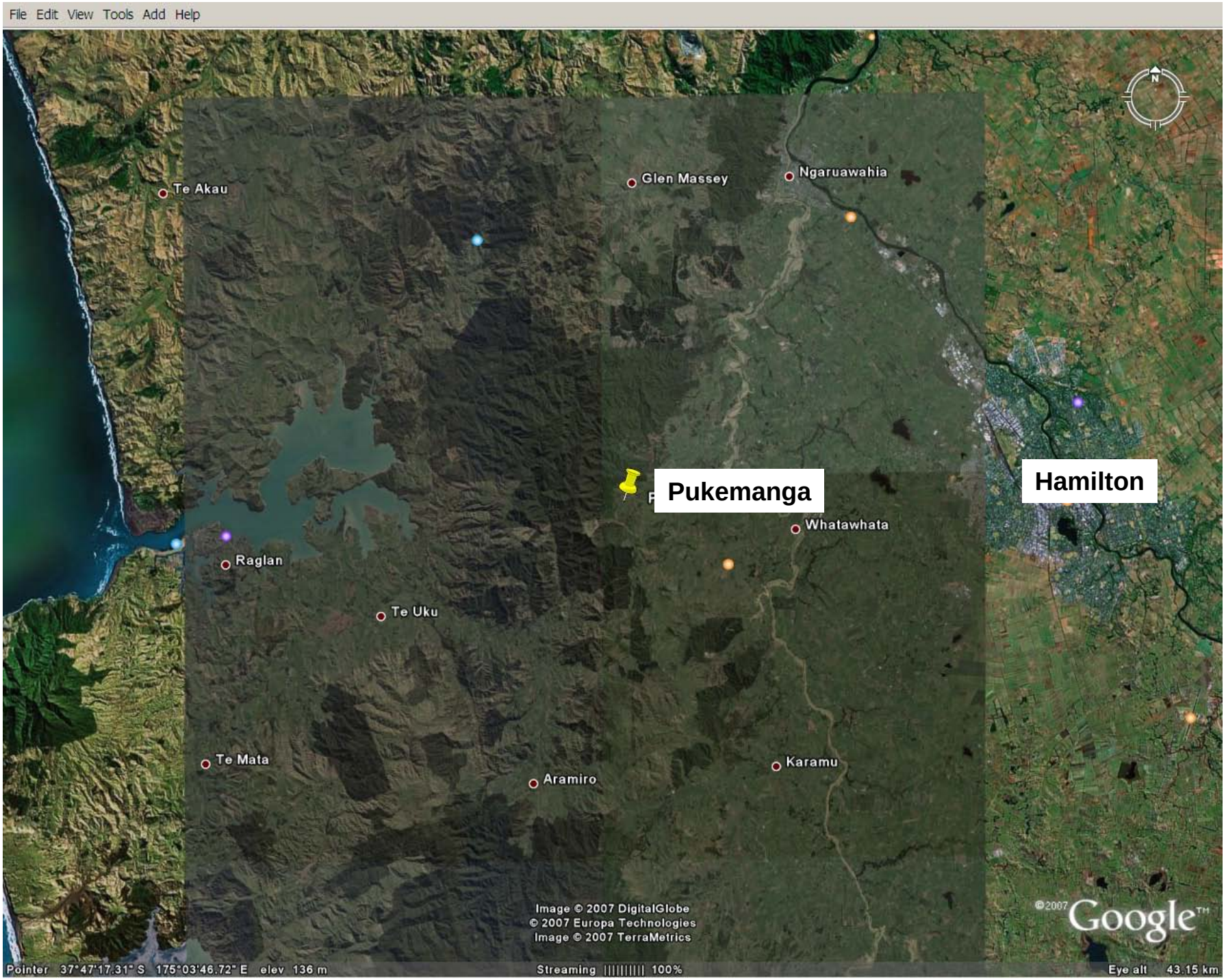
File Edit View Tools Add Help
Te Akau
Glen Massey
Ngaruawahia
Pukemanga
Hamilton
Whatawhata
Raglan
Te Uku
Te Mata
Aramiro
Karamu
Image © 2007 DigitalGlobe
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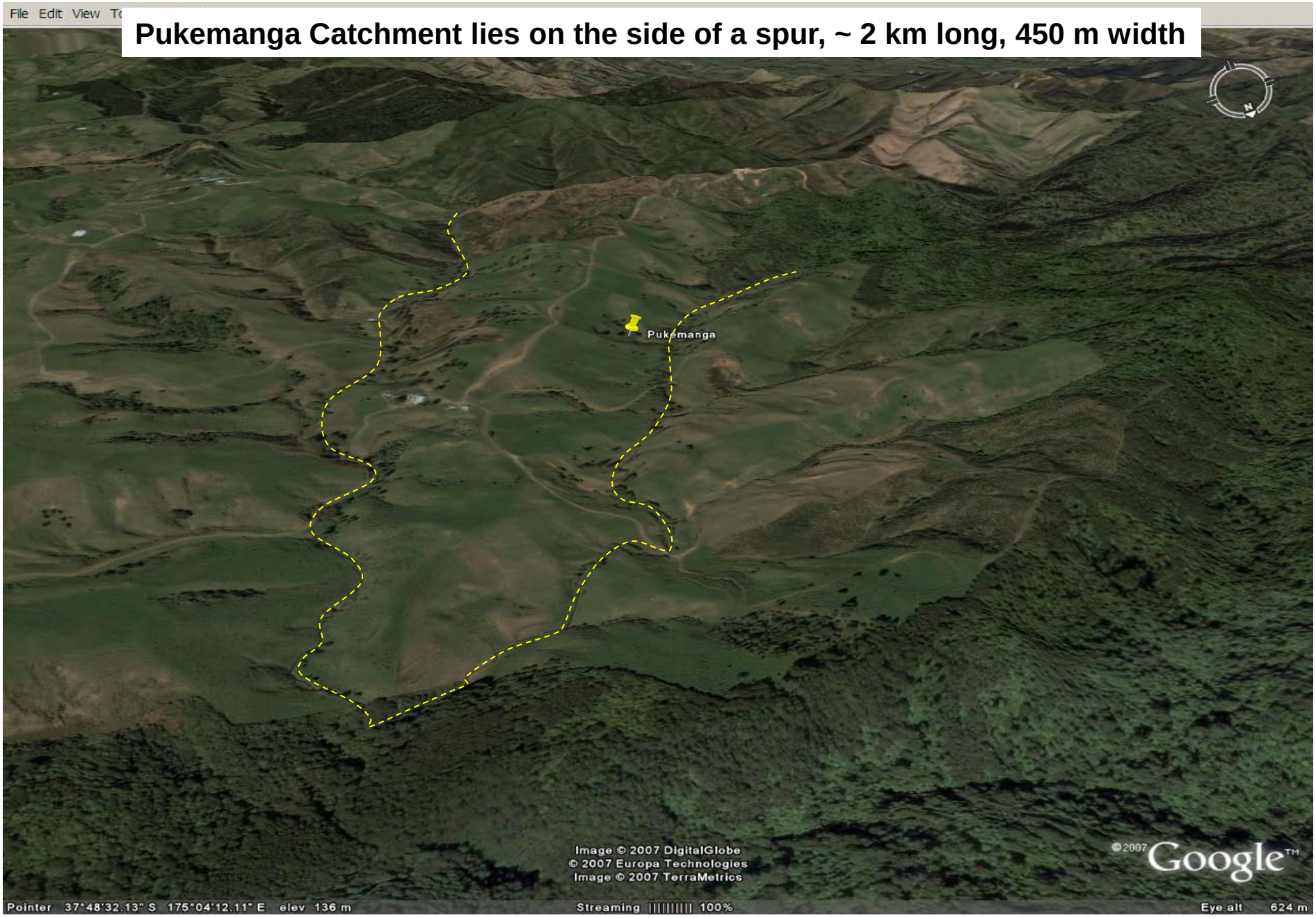
Pointer 37°47'17.31" S 175°03'46.72" E elev 136 m
Streaming 100%
Eye alt 43.15 km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Pukemanga Catchment lies on the side of a spur, ~ 2 km long, 450 m width
Pukemanga
Image © 2007 DigitalGlobe
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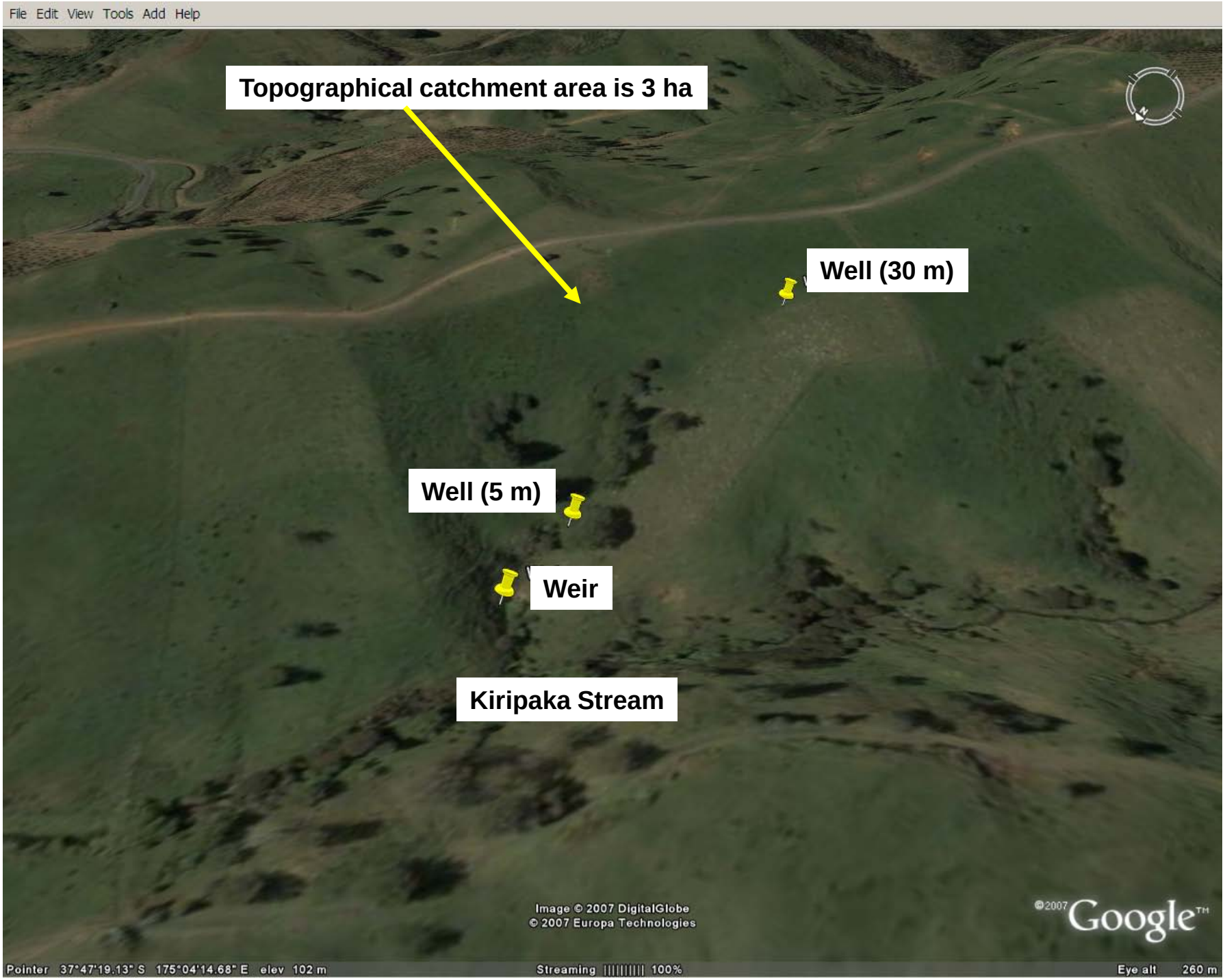
Pointer 37°48'32.13" S 175°04'12.11" E elev 136 m
Streaming 100%
Eye alt 624 m


File Edit View Tools Add Help
Topographical catchment area is 3 ha
Well (30 m)
Well (5 m)
Weir
Kiripaka Stream
Image © 2007 DigitalGlobe
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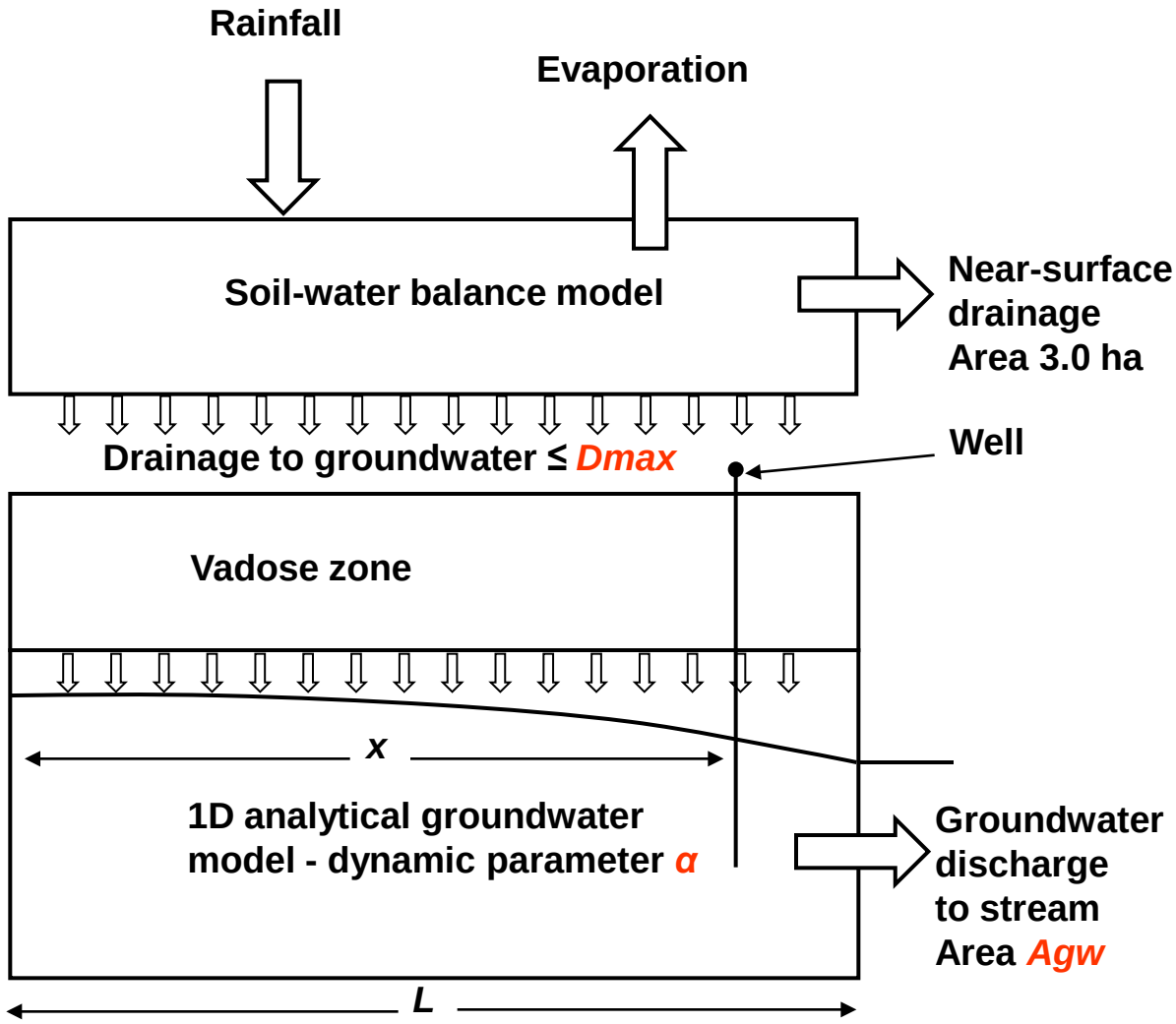
Pointer 37°47'19.13" S 175°04'14.68" E elev 102 m
Streaming 100%
Eye alt 260 m

Purpose of the analysis

- Nitrate is leached from soil under agricultural land use and transported by subsurface water flow to surface waters
- Hypothesis: groundwater is the dominant transport pathway
- Determine proportion of groundwater discharge to streamflow by partitioning of daily and hourly streamflow on the basis of groundwater dynamics

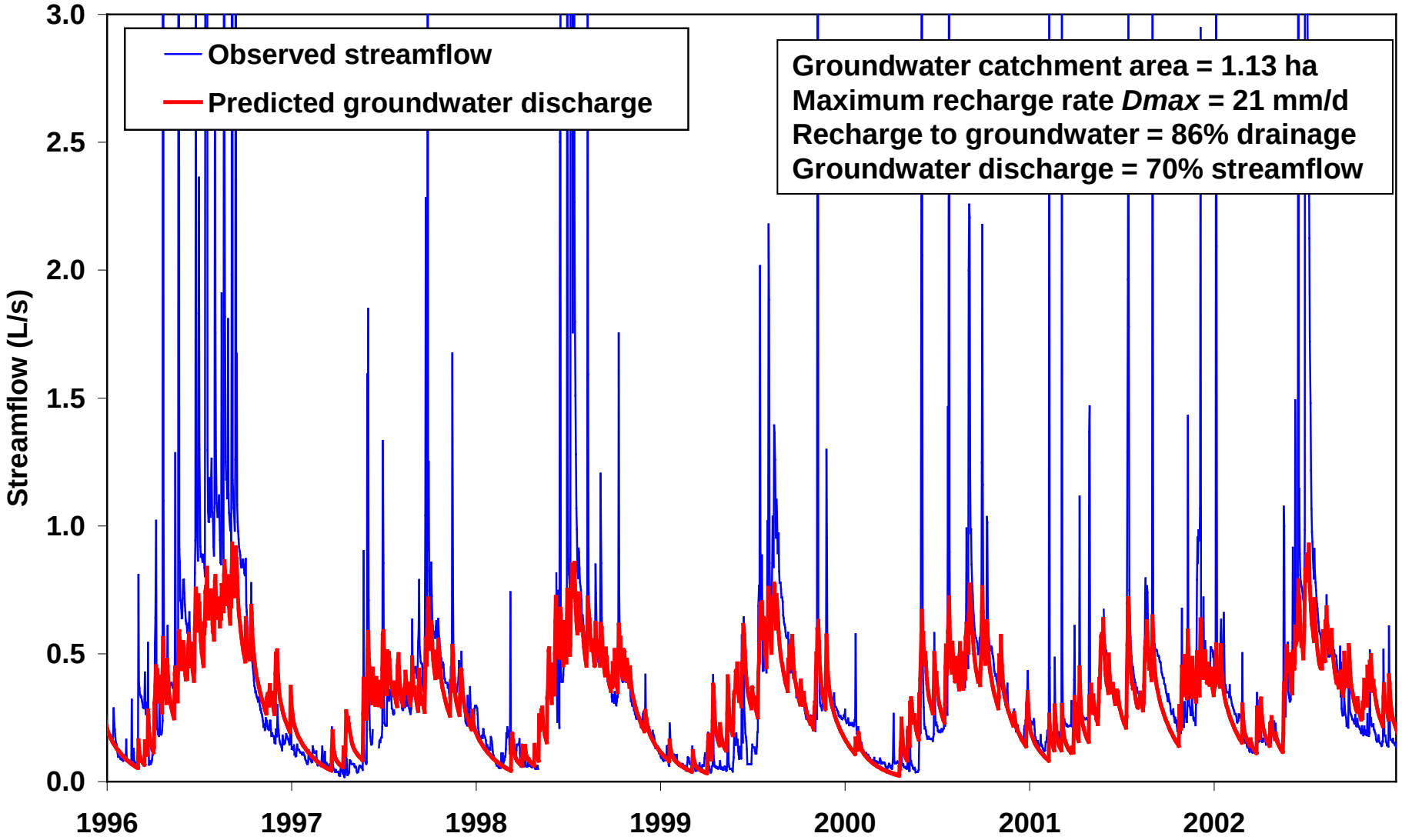
Conceptual model of catchment processes



The really important model parameters

- Groundwater catchment area – ***Agw***
- Maximum vertical drainage rate to groundwater – ***Dmax***
- Dynamic parameter ***α***, which describes the response of groundwater levels and discharge to recharge inputs

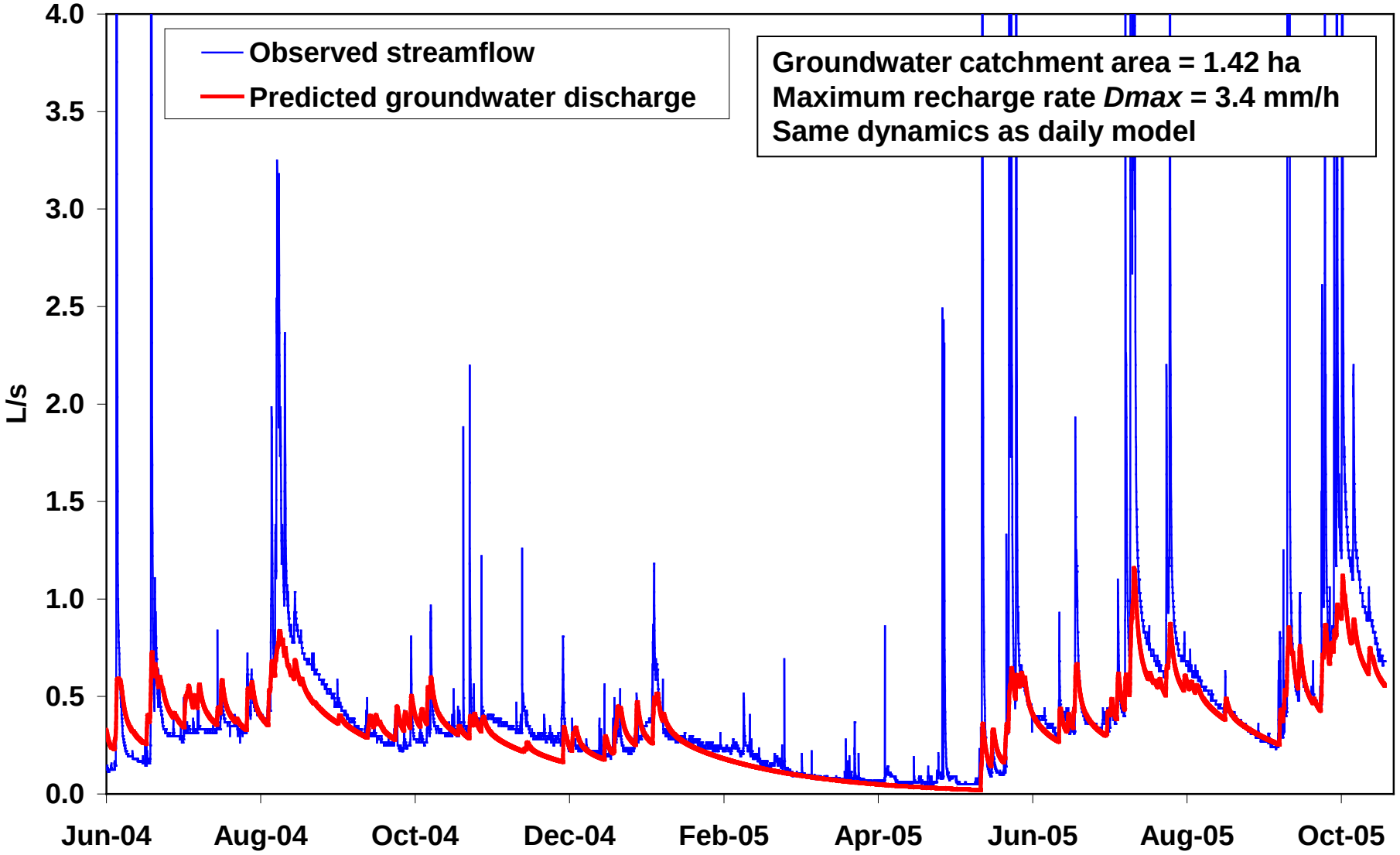
Results: daily groundwater discharge to stream



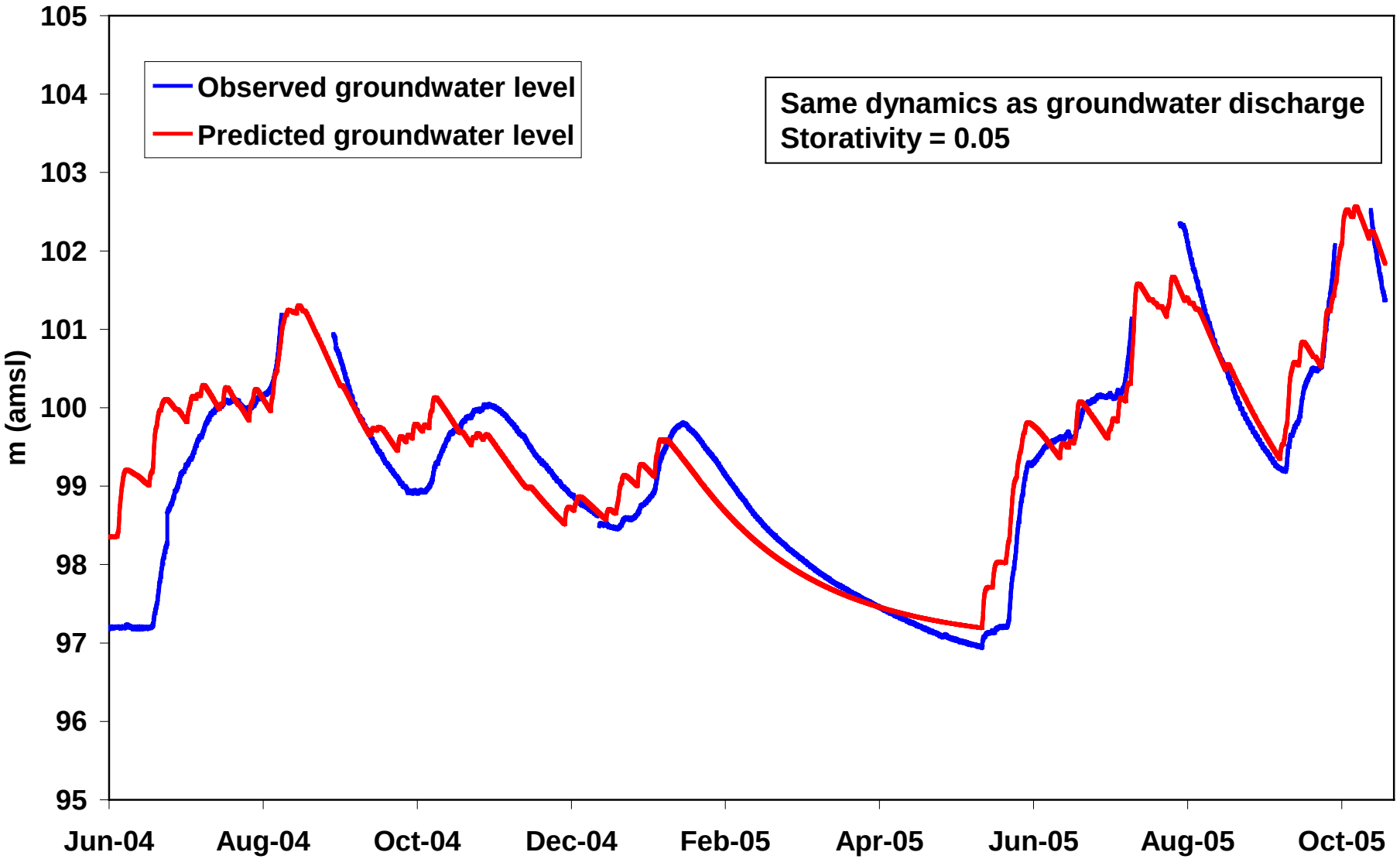
Results: annual water balance for four complete years of daily data

Year	1996	1999	2000	2002	Mean
Rainfall R (mm)	1967	1532	1565	1678	1685
Potential evaporation P (mm)	832	807	775	783	799
Predicted evaporation E (mm)	642	595	596	625	615
Predicted groundwater recharge (mm)	1128	829	794	950	1002
Predicted near-surface runoff (mm)	181	117	122	125	136
Observed mean streamflow (L/s)	0.660	0.308	0.332	0.474	0.444
Predicted mean streamflow (L/s) for:					
Agw = 3.0 ha	1.217	0.890	0.809	1.092	0.986
Error (%)	84	189	144	130	137
Agw = 1.13 ha for all years	0.556	0.410	0.345	0.498	0.452
Error (%)	-16	33	4	5	7
Agw varies annually 1.09 – 1.32 ha	0.623	0.393	0.338	0.502	0.464
Error (%)	-6	28	2	6	8

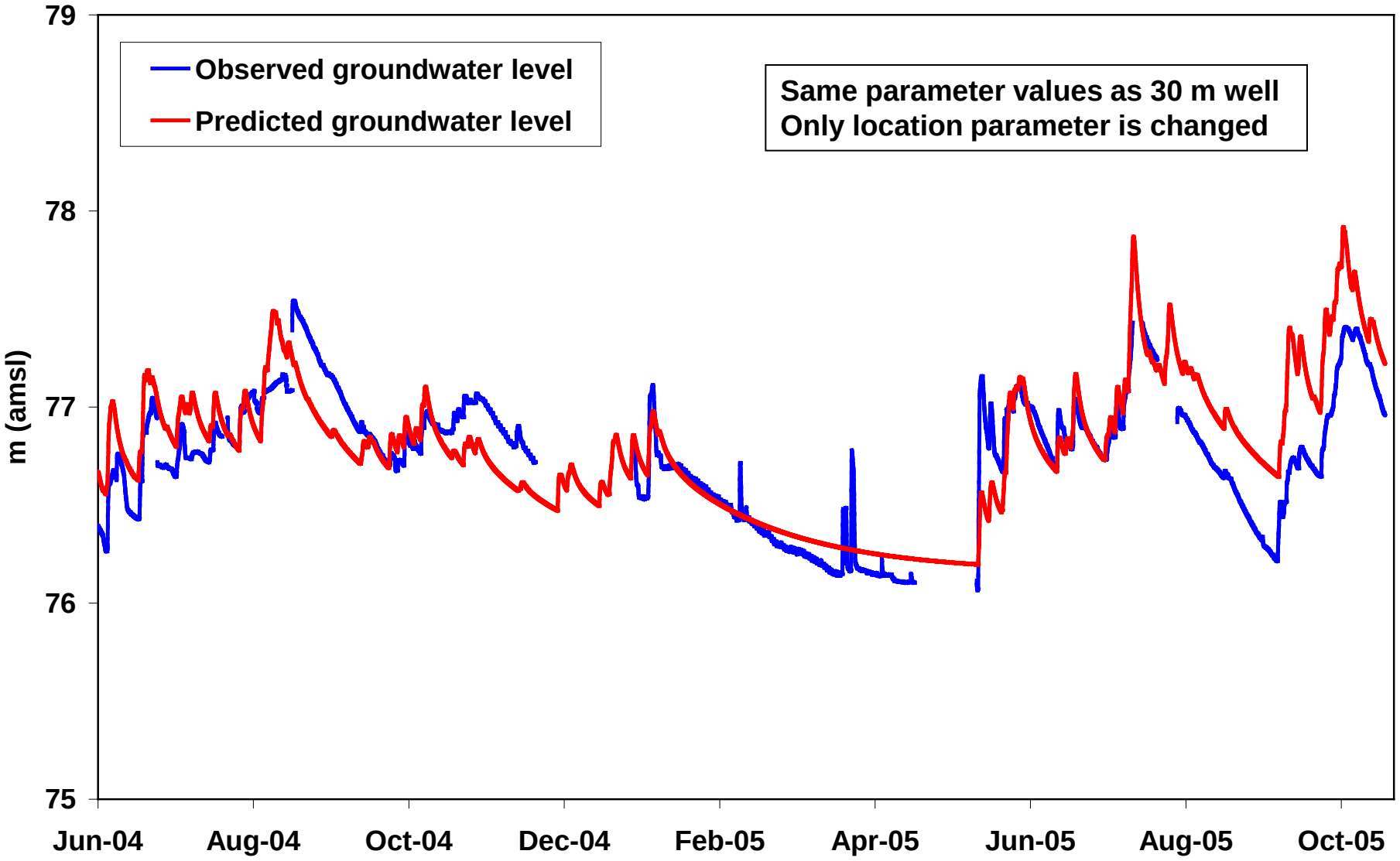
Results: hourly groundwater discharge to stream



Results: hourly groundwater level at 30 m well



Results: hourly groundwater level at 5 m well



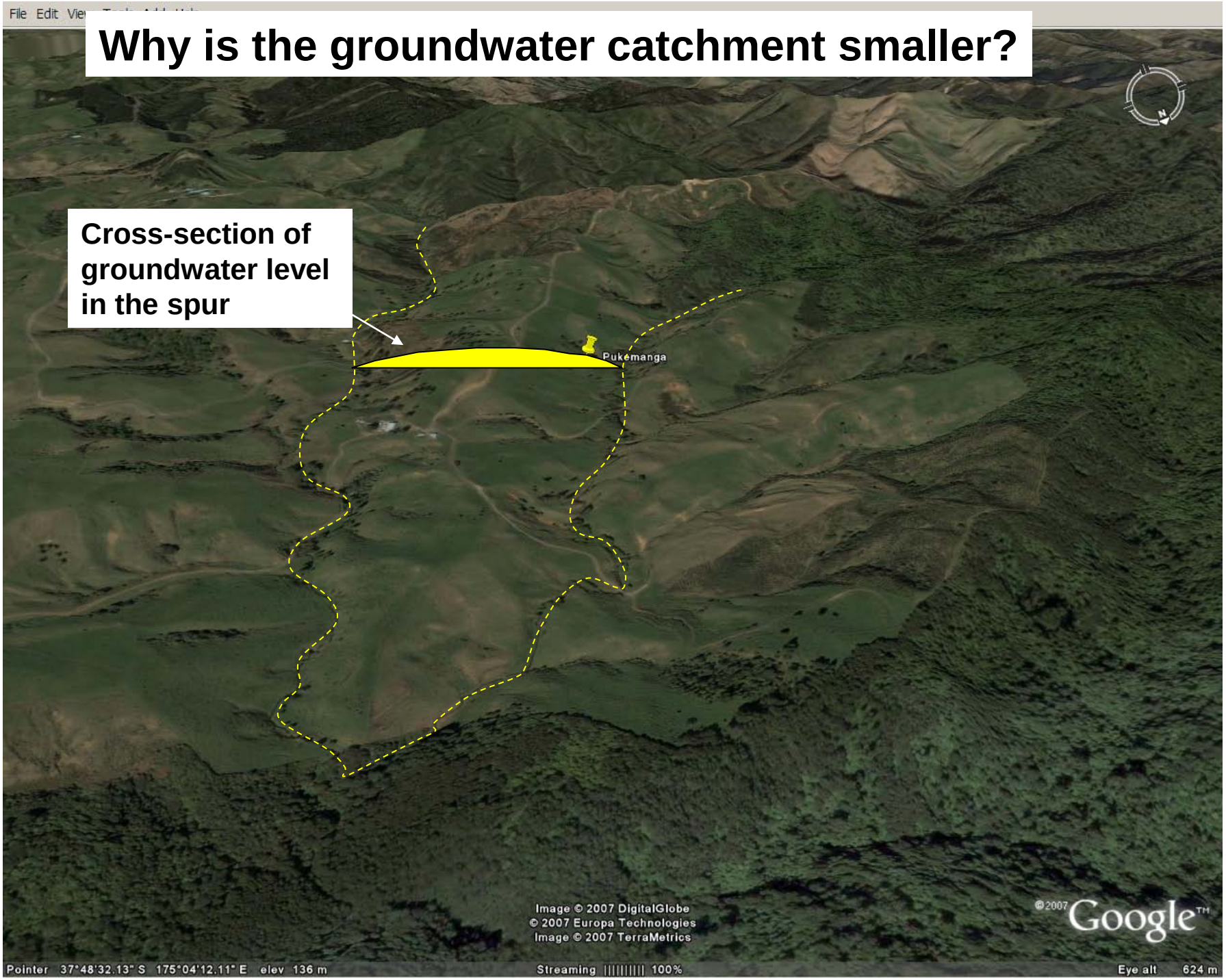
Conclusions

- For this steep, headwater catchment receiving 1700 mm mean annual rainfall, about 85% of drainage to surface water is via groundwater

- Associated maximum vertical drainage rate to groundwater is about 3.5 mm/h

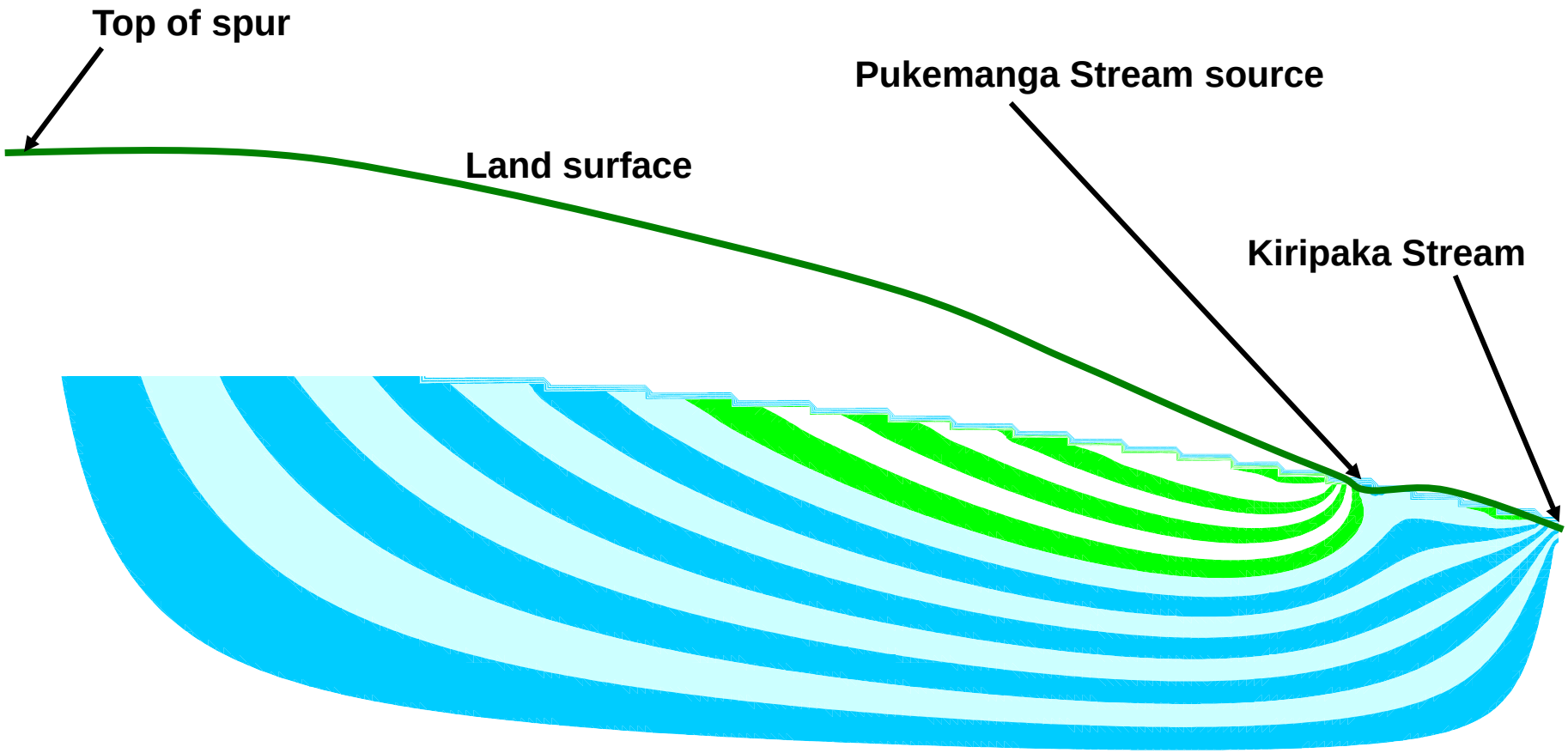
- Groundwater catchment for Pukemanga Stream does not coincide with topographical catchment

Why is the groundwater catchment smaller?



Why is the groundwater catchment smaller?

- illustrated with 2D vertical, groundwater flowline analysis



Lessons from Pukemanga
- a local confirmation of existing knowledge

- Most streamflow is sustained by groundwater, most of the time
- Groundwater transports most of the water that has leached nitrate from the soil
- The groundwater catchment does not necessarily coincide with the topograpical catchment
- This has implications for which land use affects which surface water body