



Geotechnical Report

AOKAUTERE SUBDIVISION – PACIFIC DRIVE - PROPOSED RETIREMENT
VILLAGE - PALMERSTON NORTH

09/07/2021





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Retirement Village Geotechnical Report, Pacific Drive, Palmerston North

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1.0 INTRODUCTION

1.1 BACKGROUND

Aokautere Land Holdings Ltd (ALHL), is investigating an area of land for development as an aged care facility. The location is off Pacific Drive Palmerston North, Figure 1.



FIGURE 1: LOCALITY PLAN, YELLOW PIN SHOWS SITE LOCATION

The proposed site is peri-urban, adjacent to a recent and ongoing residential development but with a rural outlook. The site was historically farmland until the early 2000's. The topography forms the top (head) of an area known as the Johnstone Drive Gully.

Earthworks within the Johnstone Drive Gully began in 2007 following the granting of consent RM2553. The work involved the stripping of the vegetation, removal of unsuitable material and the placement of subsoil drainage.

The subsoil drainage was 100 diameter novaflo in gravel trench designed to carry excess ground water plus possible flows from small springs. The pipe is observable 1km below the brethren school and is still flowing.

The material for the filling was obtained from the ridges on either side of the gully which to the west have been excavated and topsoiled to the design level. The gully fill and part of the area to the east has only been partly completed (fill and cut), the southern end being untouched. The design depth of fill ranges from 4m at the upper end to over 10m at the lower end of Stage 7 (Retirement Village) with the deeper fill areas to the north.

The filling of the upper end of the gully has nearly been completed varying from 1m to further downstream of approximately 5m. The current fill was compacted using fully loaded scrapers weighing approximately 100 tonnes i.e., 25 tonnes loading per wheel. Limited testing during the placement of the fill was performed by PNCC laboratory.

Settlement monitoring was performed following the work being suspended in June 2011. Work briefly recommenced during 2012. Monitoring of various areas up to June 2013 which showed little if any settlement of the filled areas. Work was suspended due to ESC issues not any concerns re the earthworks quality.

Water from a stormwater pipe discharging into the head of the gully that was installed by the neighbour during the earthworks has been impounded at the head of the gully and generally drains by gravity to Pacific Drive but occasionally overflows into the gully and has consequently created erosion and rilling on parts of the fill. Earthworks for excavation and filling ceased in 2012.

1.2 SCOPE

This report provides the results of Geotechnical Investigations of:

- Review of the site geology and seismicity
- Confirmation of the original nature and stability of the site,
- Provision of detailed CPT and Window Sampling on the proposed build area.
- Analysis of the implications of the measured data.

2.0 GEOLOGIC CONDITIONS AND SEISMICITY

2.1 INTRODUCTION

The local geology of the site was determined from data obtained from the GNS, PNCC, and NZGD databases. The GIS databases provided information on the sites’:

- Geology,
- Liquefaction Potential and,
- Seismicity.

2.2 LOCAL GEOLOGY

The local geology of the site as per the GNS GIS database:

- Main rock type: Gravel.
- Description: Beach deposits of marine gravels and sand with overlaying loess deposits
- Subsidiary rocks: Loess silt sand.
- Key group: Late Pleistocene sediments.

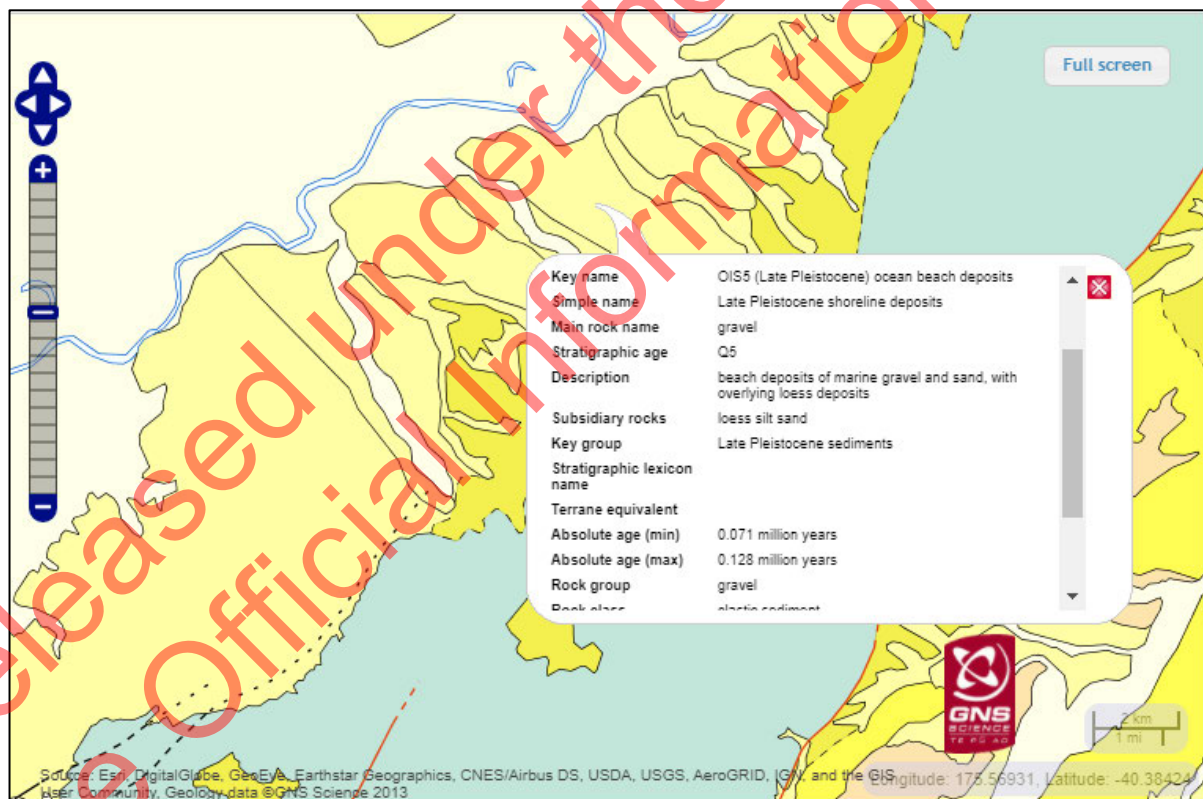


FIGURE 2: SITE GEOLOGY: MAIN ROCK TYPE: GRAVELS (LATE PLEISTOCENE SEDIMENTS) (GNS WEBMAP) SITE IS AT TAIL OF DE CRIPTOR

2.3 FAULTING AND SEISMICITY

There is limited Earthquake risk data available for the site or nearby, Figure 3 below shows a map of the potential liquefaction risks around Palmerston North, provided by GNS, which does not rate the site. The site however is in close proximity to areas rated as moderate risk, (mainly gully floors in the area).

Figure 3 below was obtained from the above report and shows the risk data for the region:

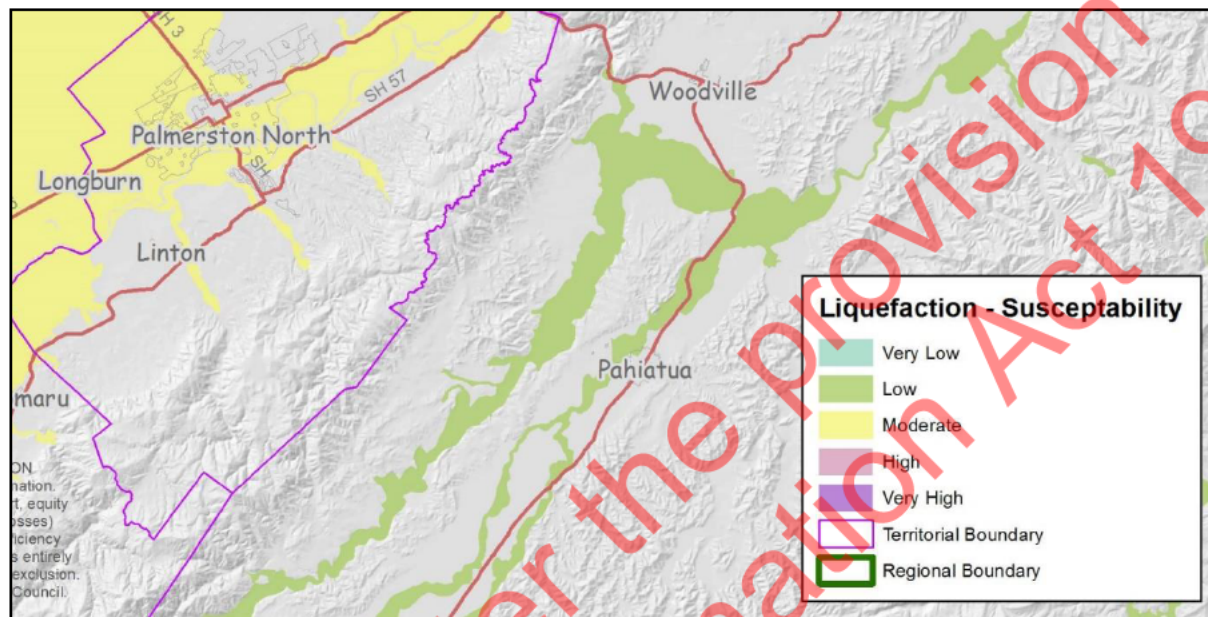


FIGURE 3: SITE LIQUEFACTION RISK

The fault proximity data was obtained from the GNS database. The database shows that there are two active faults in proximity, these active faults are:

- Wellington Fault (8.2km), and
- Northern Ohariu Fault (9.6km)

Figure 4 overleaf is a plan from the PNCC GIS database illustrating the sites' location relative to the active faults.

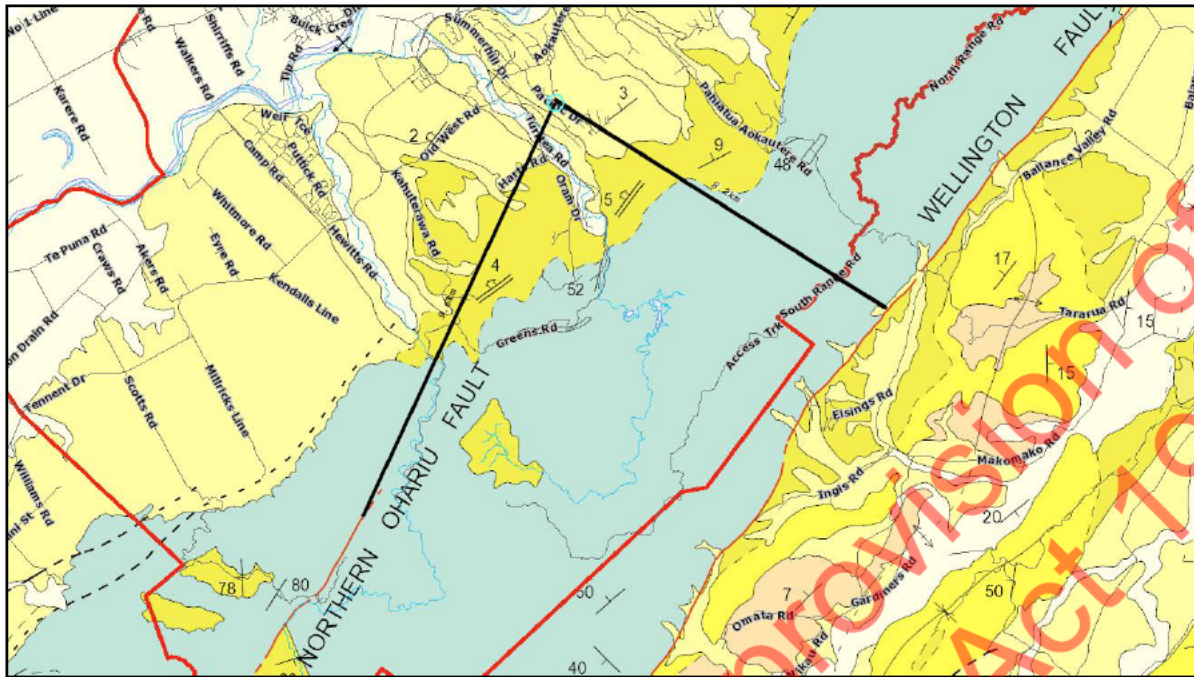


FIGURE 4: SITE LOCATION APPROXIMATELY AT BLUE CIRCLE RELATIVE TO ACTIVE FAULTS SHOWN AS PINK LINES, (GNS DATABASE)

The description of the faults are as follows:

- **The Wellington Fault** has an estimated 840-year recurrence interval and an estimated 5m maximum single event displacement under a magnitude 7.0 event.
- **Northern Ohariu Fault** has an estimated 2550-year recurrence interval and an estimated 3.8m maximum single event displacement under a magnitude 7.4 event.

It is also of note that the trend line of the northern Ohariu fault is heading towards the site. The justification for the termination is unknown.

3.0 GEOTECHNICAL PARAMETERS

3.1 HISTORICAL EARTHWORKS

There has been substantial filling applied to the main gully which passes through the proposed site. This is identified in the earthworks control plan as per Figure 5 below.

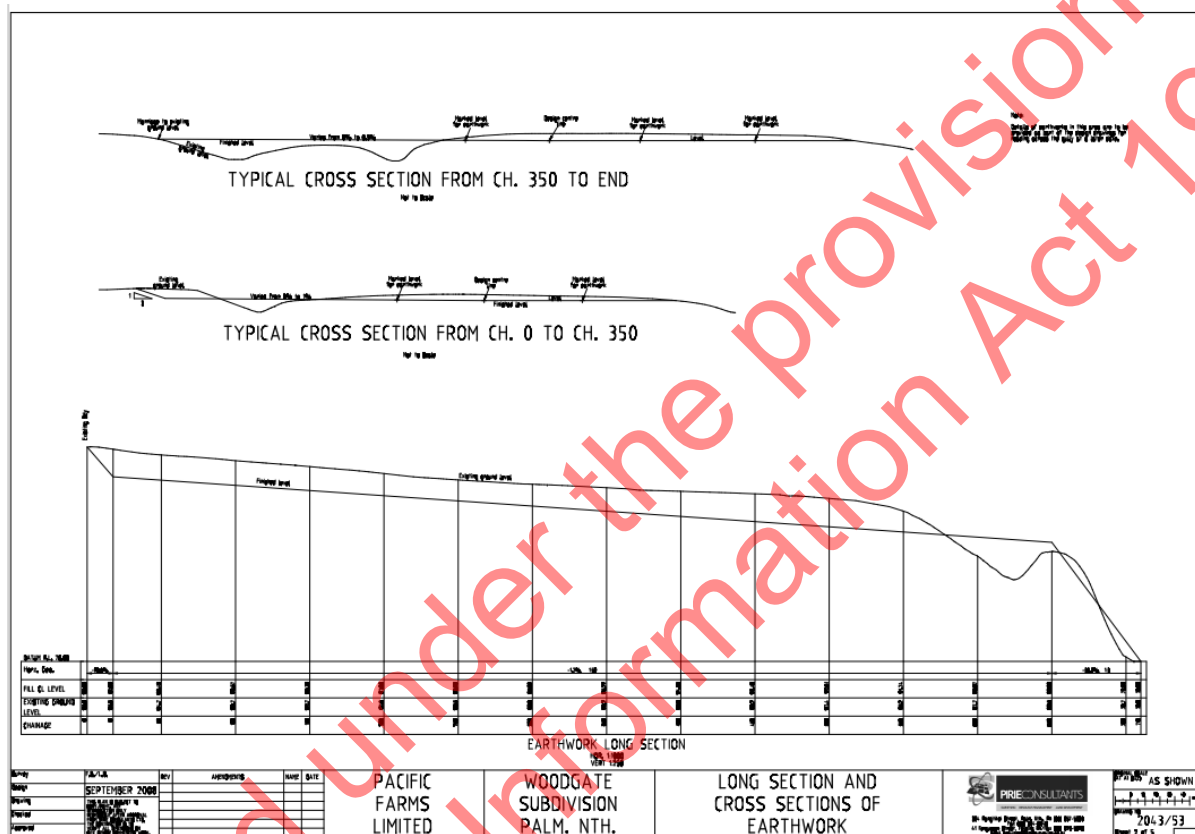


FIGURE 5. LOCATION OF 3X SECTIONS FROM 6G1

The earthworks were undertaken using appropriate heavy plant and monitoring to determine good consolidation. Subsoil drains were also included prior to the gully filling, Figure 6.



FIGURE 6. SITE EARTHWORKS.

3.2 CPT TESTING

Initial investigations into the site suitability comprised extensive CPT testing on the existing landform. The testing is intended to further prove ground strengths of filled areas, confirm ground strengths of original ground areas, confirm the GNS assessment of minimal liquefaction risk, and identify likely foundation strengths and settlements for future construction.

A plan of the intensive CPT testing shown overlaid on the proposed site development plan is provided below in Figure 7. The triangles are CPT tests, and the squares are window sampling sites.

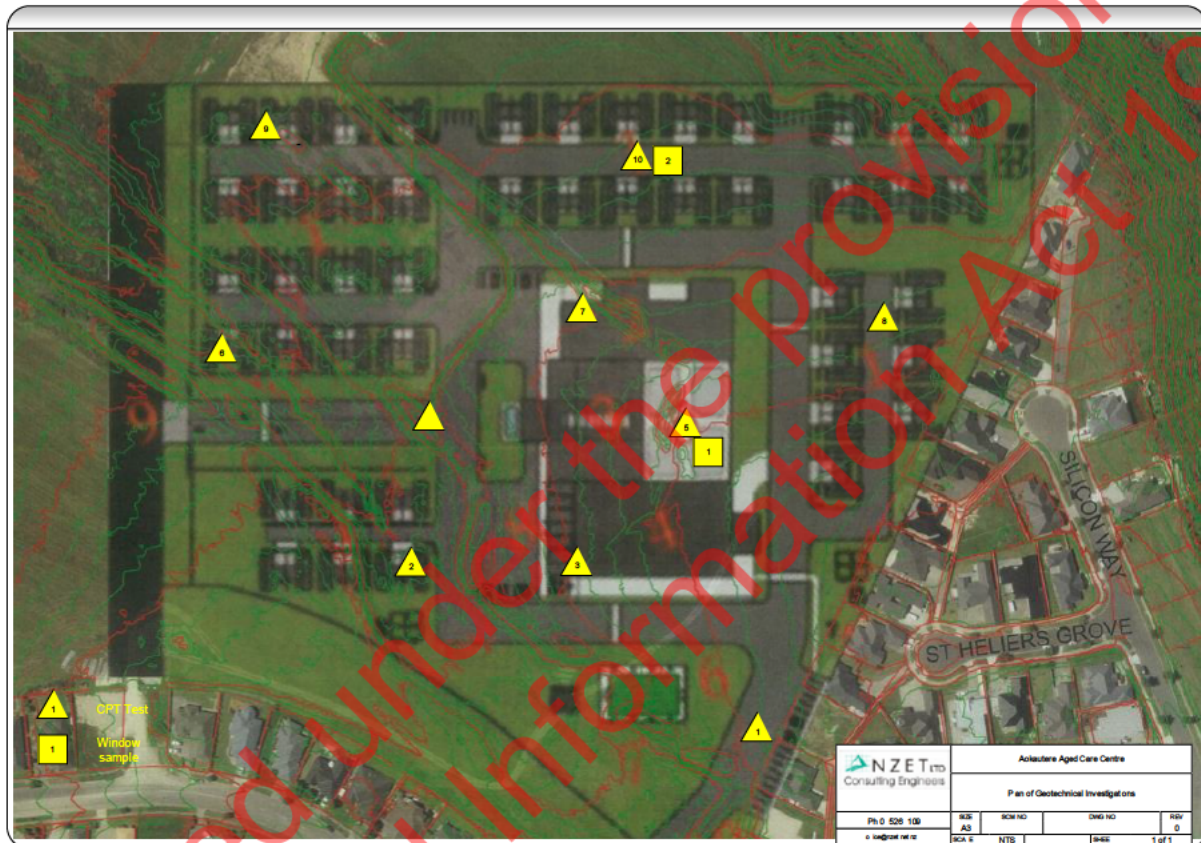


FIGURE 7: CPT TEST LOCATIONS

The CPT results are attached as Annex A to this report. An example of the 13 test holes, hole 5 in the location of the main building is shown in Figure 8 below. Each plot shows the tip resistance as a chart in the top right, in interpretation as to soil type using NZET's Cpet-It software below (titled SBT index), interpretation of the soil type based on Geocivil's software, (3 coloured charts and coloured legend centre right, and associated ultimate capacity foundation strengths using NZET's Cpet-IT software (multiple charts).



FIGURE 8. EXAMPLE OF CPT RESULTS AND INTERPRETATION.

3.3 WINDOW SAMPLING

To confirm CPT interpretation of soil descriptions, two window samples were taken at CPT locations 5 and 10. The window sampling involved extracting relatively undisturbed samples via tube samplers and geotechnical logging of same. An example report is given in figure 9 overleaf.

GEO CIVIL TEST RIGHT • BUILD RIGHT		WINDOW SAMPLE LOG PRELIMINARY				47C Kenepeanu Drive, Wellington M 021796477 E info@geocivil.co.nz		
Lab Job No: 8625-001		Borehole No.: WS01		Sheet: 1 of 1				
Client: KHP Development		Hole Depth: 6.00 m		Location: Pacific Drive, Palmerston North				
Job: Geotechnical Investigation		Coordinates:		Elevation (m):				
Report No.: ADD INTERNAL REPORT NUMBER!		Date: 01/07/21						
Client Ref. No.: -								
LOG	Geological Interpretation <small>In accordance with NZS38 2006</small>	Depth (m)	Legend	Water	Scale Penetrometer <small>NZS38 2006 Table 6.3.2 - Procedure 2 (Scale: 1:100mm)</small>			Vane Shear <small>(Strength MPa) Tested in accordance with NZS38 2006</small>
					1	10	100	
ML	Clayey SILT (TOPSOIL) with rootlets, dark brown, soft, moist, low plasticity	0.2						
CL	Silty CLAY, light grey with orange streaking, stiff to firm, moist to wet, low to moderate plasticity	0.4						
ML	Sandy SILT with minor clay, light grey, stiff, moist, poorly graded, low to moderate plasticity; sands are fine	1.0						
CH	Silty CLAY, dark orange with grey mottling, very stiff to stiff, moist to wet, moderate to high plasticity	1.2						
CH	Silty CLAY, dark brownish grey with dark orange mottling, very stiff to stiff, moist to wet, moderate to high plasticity	2.0						
CL	Silty CLAY with minor gravels and carbonaceous material, dark brownish orange with black nodules, very stiff, moist to wet, poorly graded, moderate plasticity; gravels are fine to medium, completely weathered, angular, moderately strong to weak	3.0						
MH	Silty CLAY, dark brownish orange, hard to very stiff, moist to wet, moderate plasticity	3.8						
SW	SAND with minor gravels, dark brownish orange, very dense to dense, moist, well graded; gravels are fine to medium, highly weathered, angular, moderately strong to strong; sands are fine to coarse	4.8						
CH	CLAY with minor silt, dark orange with grey streaking, hard, moist to wet, moderate to high plasticity	5.8						
	End of borehole; target depth reached	6.0						
Remarks					Water		Investigation Type	
Test location 5					<input type="checkbox"/> Standing Water Level <input type="checkbox"/> Out flow <input type="checkbox"/> In flow		<input checked="" type="checkbox"/> Window Sampler <input type="checkbox"/> Window Sampler + Scale (DSCP)	
<small>Note: All Scale Penetrometer readings taken below 1 dm from start depth are outside the scope of this test</small>								
<small>Note: Scale Penetrometer interpretation is not endorsed</small>								
Contractor: Geocivil		Equipment: Window Sampler		Recorded By: L.O./J.R.		Checked By: NOT SELECTED		Supervisor: No accredited tests
				Recorded Date: 1/07/2021		Checked Date:		

FIGURE 9. EXAMPLE OF WINDOW SMAPLING LOG.

4.0 SUMMARISED FOUNDATION PROPERTIES

This data is interpreted as generally indicating:

- Soil type varies from clayey silts to sands
- No groundwater was encountered and therefore the liquefaction risk is considered to be low.
- Soils were firm and should provide good foundation support to commercial scale buildings.
- CPT interpretation of soils description was generally confirmed by window sampling on 2 sites.

The extracted window samples are held by NZET and further testing is being undertaken to identify specific soil characteristics and properties.

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ANNEX A: CPT RESULTS AND INTERPRETATION

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ANNEX B: WINDOW SAMPLING RESULTS

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