

# District overview of travel time to ART facilities: Lilongwe City

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## Objectives

- Map the estimated prevalence and number of people living with HIV (PLHIV) by approximately 1 km grid cells.
- Estimate the travel time to the nearest ART facility for PLHIV in Malawi.
- Identify optimal locations for additional facilities with ART service to reach PLHIV with long travel times to existing ART facilities (>60, 90, or 120 minutes).

Interactive results are available at: [https://mrc-ide.github.io/mwi-hiv/ART\\_facilities/index.html](https://mrc-ide.github.io/mwi-hiv/ART_facilities/index.html).

## HIV prevalence and PLHIV estimates

Figure 2 illustrates estimates for spatial HIV prevalence for adults aged 15–49 years. Figure 3 shows the estimated number of PLHIV (all ages), and the locations of health facilities with ART services (labelled with A) and without current ART services (labelled with F).

Table 1: Summary estimates for Lilongwe City, September 2020.

Total PLHIV (all ages)	87,905 (77,544–98,717)
HIV prevalence, age 15–49 years	11.4% (10.1%–12.8%)
Total patients receiving ART	65,074
Average walking time to nearest ART (minutes)	18 (17–18)
Number PLHIV > 60 minutes walking time	240 (173–333)
Percentage PLHIV > 60 minutes walking time	0.3% (0.2%–0.4%)

Table 2: Traditional authorities with the lowest and highest estimated number of PLHIV, 15-49 Prevalence, and average walking time, respectively.

	Lowest TA	Largest TA
PLHIV	Multiple: 0 (0–0)	Area 25: 9,288 (7,495–11,596)
15-49 Prevalence	Area 53: 6.9% (4.9%–9.5%)	Area 5: 13.6% (11.2%–16.1%)
Average Walking Time	Area 14: 1 min (1–1 min)	Area 55: 45 min (43–46 min)

## Travel time to existing ART facilities

In Lilongwe City, there are 22 ART facilities that had at least 1 patient in September 2020. The median number of ART patients per facility was 1330. The list of *active ART facilities* is in Table 4. Private not-for-profit facilities have been excluded from the analysis. Figure 4 shows the modelled travel times to the nearest active ART facility. The average walking time to the nearest facility for residents in each traditional authority are in (Figure 5).

- The estimated average walking time for PLHIV to the closest ART facility across Lilongwe City is 18 minutes (17–18 min).
- The shortest estimated average walking time to the closest ART facility is in Area 14 (1 minutes (1–1 min)).
- The longest estimated average walking time to the closest ART facility is in Area 55 (45 minutes (43–46 min)).

An estimated 0.3% (0.2%–0.4%) of PLHIV reside more than 60 minutes walking time to their nearest ART facility, compared to 0.6% of the total population. This decreases to 0.0% (0.0%–0.0%) of PLHIV and 0.0% of the total population residing more than 90 minutes walking time to their nearest ART facility. More details are provided in Table 3.

Table 3: Estimated PLHIV and population not reached at different thresholds

Threshold (minutes)	Population not reached	As % of total population	PLHIV not reached	As % of total estimated PLHIV
45	20,746	2.0%	1,130 (945–1,352)	1.3% (1.1%–1.6%)
60	6,005	0.6%	240 (173–333)	0.3% (0.2%–0.4%)
90	0	0.0%	0 (0–0)	0.0% (0.0%–0.0%)
120	0	0.0%	0 (0–0)	0.0% (0.0%–0.0%)

## Proposed facilities for new ART services

A list of 16 *non-ART facilities* were considered to identify existing health facility locations for expanding ART services, listed in Table 5. Figure 6 shows the number of PLHIV in grid cells where the estimated travel time is longer than 60 minutes and candidate new ART facilities.

- The TA with the largest number of PLHIV residing more than 60 minutes from their closest ART facility is Area 55 (218 PLHIV (156-301) with walking time > 60 minutes).
- The facility that can reach the most PLHIV residing outside 60 minutes travel time is **Chimwala HC**, with 792 PLHIV (579-1024) reached.

## Limitations

There are several important limitations to this analysis:

- Travel time surfaces and catchments may not optimally reflect typical routine travel or movement patterns, for example for work or other activities.
- Results do not represent uncertainty in the 1km gridded maps of PLHIV arising from uncertainty about the gridded populations.
- There are discrepancies in the gridded HIV prevalence estimates from the Bayesian geostatistical model and the Naomi estimates for some districts which should be further reviewed, especially neighbouring urban and rural districts.
- Geographic locations of some health facilities are discrepant between multiple data sources and need to be confirmed.
- The physical infrastructure and suitability of candidate health facilities for supporting an ART service is unknown.
- Optimisation analysis for locations for new facilities has not considered overcrowding, wait times, or other barriers to access at existing facilities. It could be more optimal to expand services in some geographically dense locations to address barriers to access.

## **Summary figures and maps**

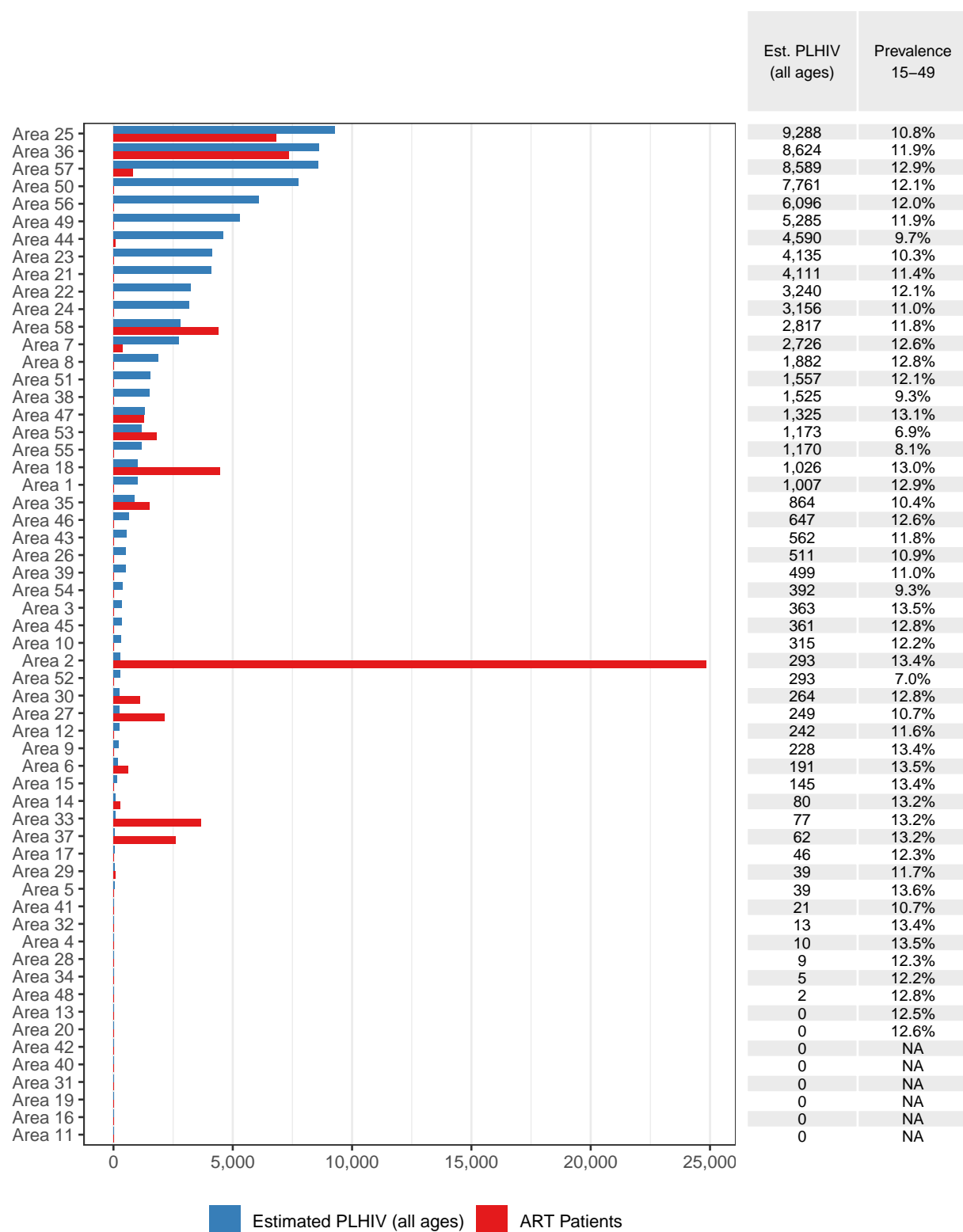


Figure 1: Number registered ART clients within each TA and estimated number of PLHIV within the TA. The right table indicates the estimated 15-49 HIV prevalence.

## HIV prevalence in ages 15-49

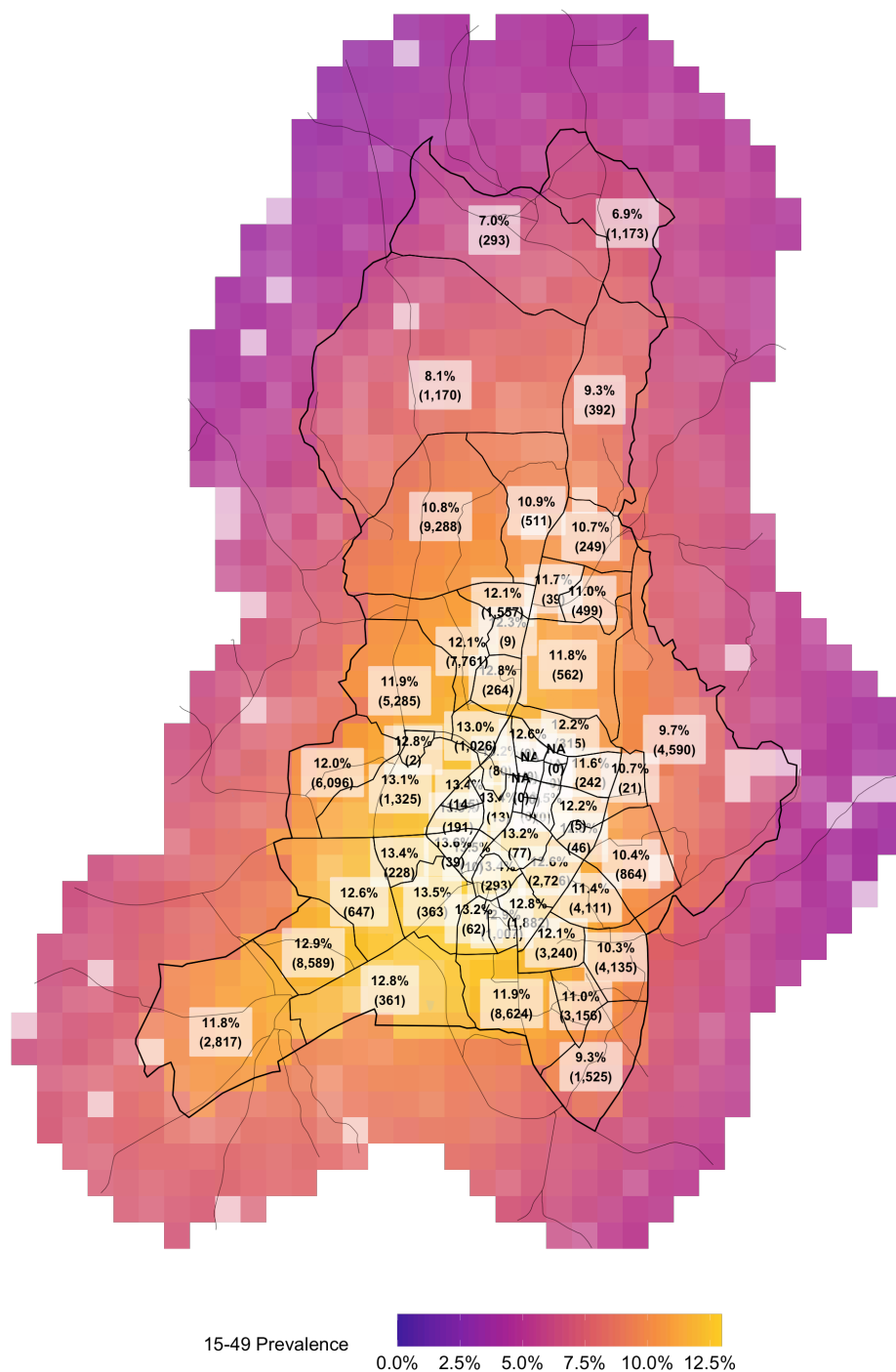


Figure 2: Estimated spatial HIV prevalence. Percentages correspond to TA level 15-49 HIV prevalence and numbers in brackets indicate the estimated number of PLHIV overall.

## Estimated number of PLHIV at 1km square

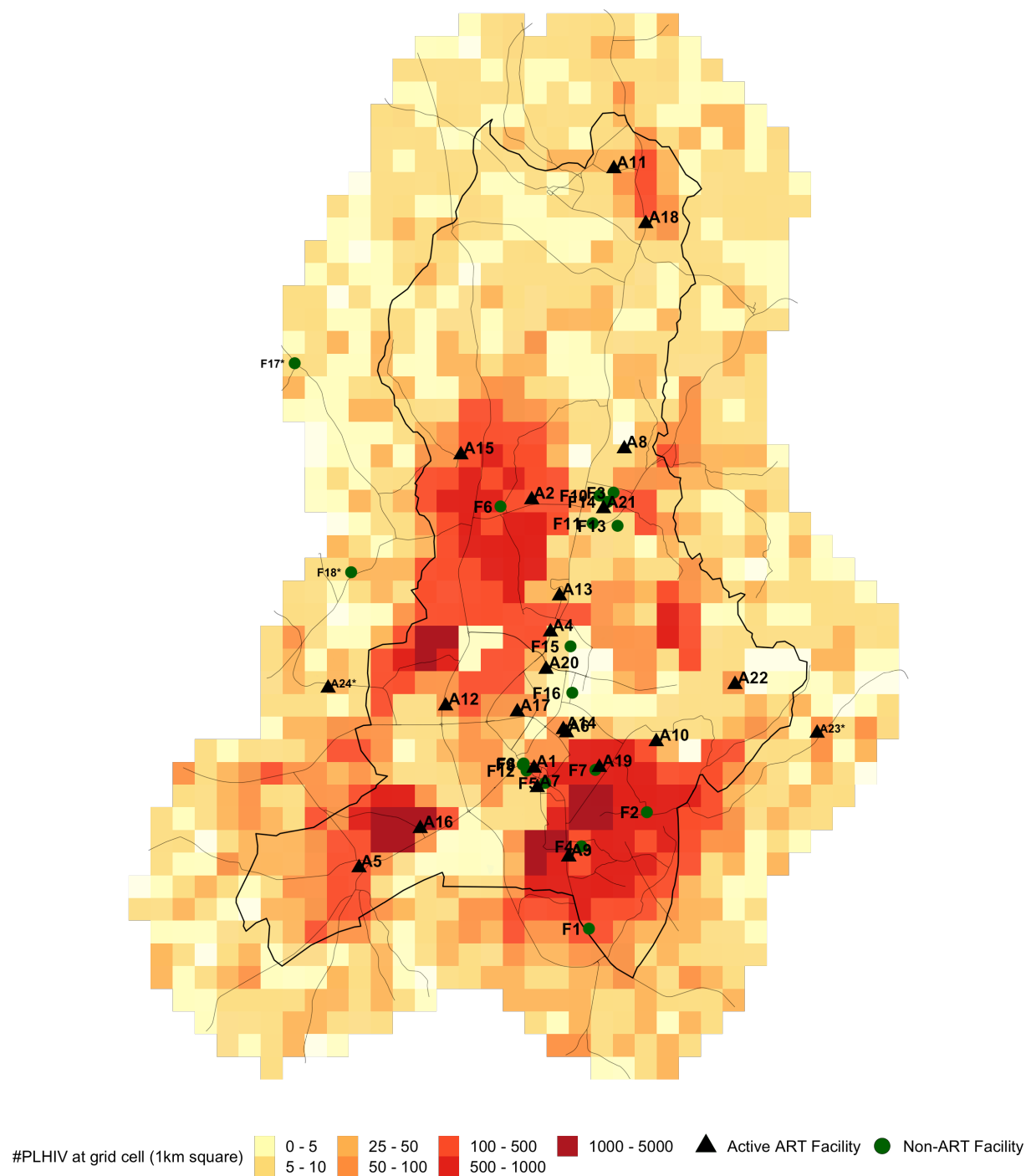


Figure 3: Estimated number of PLHIV on a 1km square.

Table 4: List of active ART facilities that had at least 1 registered ART patient in September 2020. The column "ART" indicates how many ART patients are registered at the ART facility. Facilities outside the district boundaries that may be accessible to residents within the district are marked with "\*\*".

ID	District	TA	Name	Type	Authority	Long.	Lat.	ART
A1	Lilongwe City	Area 2	Bwaila Hosp.	District hospital	Government	33.77	-13.99	24846
A2	Lilongwe City	Area 25	Area 25 HC	Health centre	Government	33.77	-13.89	5883
A3	Lilongwe City	Area 36	Partners In Hope Clinic	Special	NGO	33.79	-14.02	5417
A4	Lilongwe City	Area 18	Area 18 HC	Health centre	Government	33.78	-13.94	4461
A5	Lilongwe City	Area 58	Likuni Mission Hosp.	District hospital	CHAM	33.71	-14.03	4385
A6	Lilongwe City	Area 33	Baylor Childrens Centre Of Excellence In Malawi	Central hospital	NGO	33.79	-13.98	2623
A7	Lilongwe City	Area 37	MACRO Lilongwe	Special	NGO	33.78	-14.00	2611
A8	Lilongwe City	Area 27	Daeyang Luke Hosp.	Other hospital	CHAM	33.81	-13.87	2148
A9	Lilongwe City	Area 36	Partners In Hope Clinic	Special	NGO	33.79	-14.02	1922
A10	Lilongwe City	Area 35	Kamuzu Barracks	Special	Other	33.82	-13.98	1509
A11	Lilongwe City	Area 53	Lumbadzi HC	Health centre	Government	33.81	-13.77	1392
A12	Lilongwe City	Area 47	African Bible College Clinic	Special	CHAM	33.74	-13.97	1268
A13	Lilongwe City	Area 30	Area 30 Police Clinic	Special	Other	33.78	-13.93	1099
A14	Lilongwe City	Area 33	Kamuzu Central Hosp.	Central hospital	Government	33.79	-13.98	1042
A15	Lilongwe City	Area 25	Dzenza HC	Health centre	CHAM	33.75	-13.88	936
A16	Lilongwe City	Area 57	Lilongwe City Assembly Chinsapo	Special	Government	33.73	-14.01	801
A17	Lilongwe City	Area 6	Maula Prison HC	Health centre	Other	33.77	-13.97	599
A18	Lilongwe City	Area 53	Blessings Hosp.	Other hospital	Private	33.82	-13.79	408
A19	Lilongwe City	Area 7	FPAM Clinic Kawale	Health centre	NGO	33.80	-13.99	383
A20	Lilongwe City	Area 14	Adventist HC Lilongwe	Other hospital	CHAM	33.78	-13.95	281
A21	Lilongwe City	Area 29	Alliance One Clinic	Special	Private	33.80	-13.90	98
A22	Lilongwe City	Area 44	New State House Disp.	Dispensary	Government	33.85	-13.96	80
A23*	Lilongwe	TA Tsabango	Kang'oma HC	Health centre	Government	33.88	-13.98	483
A24*	Lilongwe	TA Njewa	Airwing Clinic	Health centre	Other	33.70	-13.96	399

Table 5: List of non-ART facilities considered in the analysis. The column "PLHIV" indicates the number of PLHIV that currently need more than 60 minutes to walk to the closest ART facility but less than 60 minutes to the listed health facility in the table. Facilities outside the district boundaries that may be accessible to residents within the district are marked with "\*\*".

ID	District	TA	Name	Type	Authority	Long.	Lat.	PLHIV	95% CI
F1	Lilongwe City	Area 38	Chimwala HC	Health Centre	Government	33.80	-14.05	792	(579-1024)
F2	Lilongwe City	Area 23	Mlodza SDA Disp.	Dispensary	CHAM	33.82	-14.01	142	(105-183)
F3	Lilongwe City	Area 29	Africa Leaf Clinic Kanengo	Clinic	Company	33.80	-13.89	1	(0-1)
F4	Lilongwe City	Area 36	SOS Clinic	Special	NGO	33.79	-14.02	0	(0-0)
F5	Lilongwe City	Area 1	BLM Falls	Special	NGO	33.78	-14.00	0	(0-0)
F6	Lilongwe City	Area 25	BLM Area 25	Special	NGO	33.76	-13.89	0	(0-0)
F7	Lilongwe City	Area 7	BLM Kawale	Special	NGO	33.80	-13.99	0	(0-0)
F8	Lilongwe City	Area 3	City Assembly Health	Clinic	Government	33.77	-13.99	0	(0-0)
F9	Lilongwe City	Area 3	Lilongwe City Assembly Staff C	Clinic	Government	33.77	-13.99	0	(0-0)
F10	Lilongwe City	Area 29	Auction Holdings Clinic	Clinic	Company	33.80	-13.89	0	(0-0)



F11	Lilongwe City	Area 29	Carlsberg / Sobo Clinic Lilong	Clinic	Company	33.80	-13.90	0	(0-0)
F12	Lilongwe City	Area 3	Escom Clinic Lilongwe	Clinic	Company	33.77	-13.99	0	(0-0)
F13	Lilongwe City	Area 39	Kanengo Tobacco Processors Cli	Clinic	Company	33.81	-13.90	1	(0-1)
F14	Lilongwe City	Area 29	Limbe Leaf Tobacco Co. Ltd. CI	Clinic	Company	33.80	-13.89	0	(0-0)
F15	Lilongwe City	Area 20	MoH Hq	Clinic	Government	33.79	-13.95	0	(0-0)
F16	Lilongwe City	Area 16	Reserve Bank of Malawi Clinic	Clinic	Company	33.79	-13.96	0	(0-0)
F17*	Lilongwe	TA Mtema	MNGWANGWA	Health Post	Government	33.68	-13.84	442	(315-590)
F18*	Lilongwe	TA Njewa	BULI	Health Post	Government	33.71	-13.92	0	(0-0)

## Travel Times to Closest ART Facilities

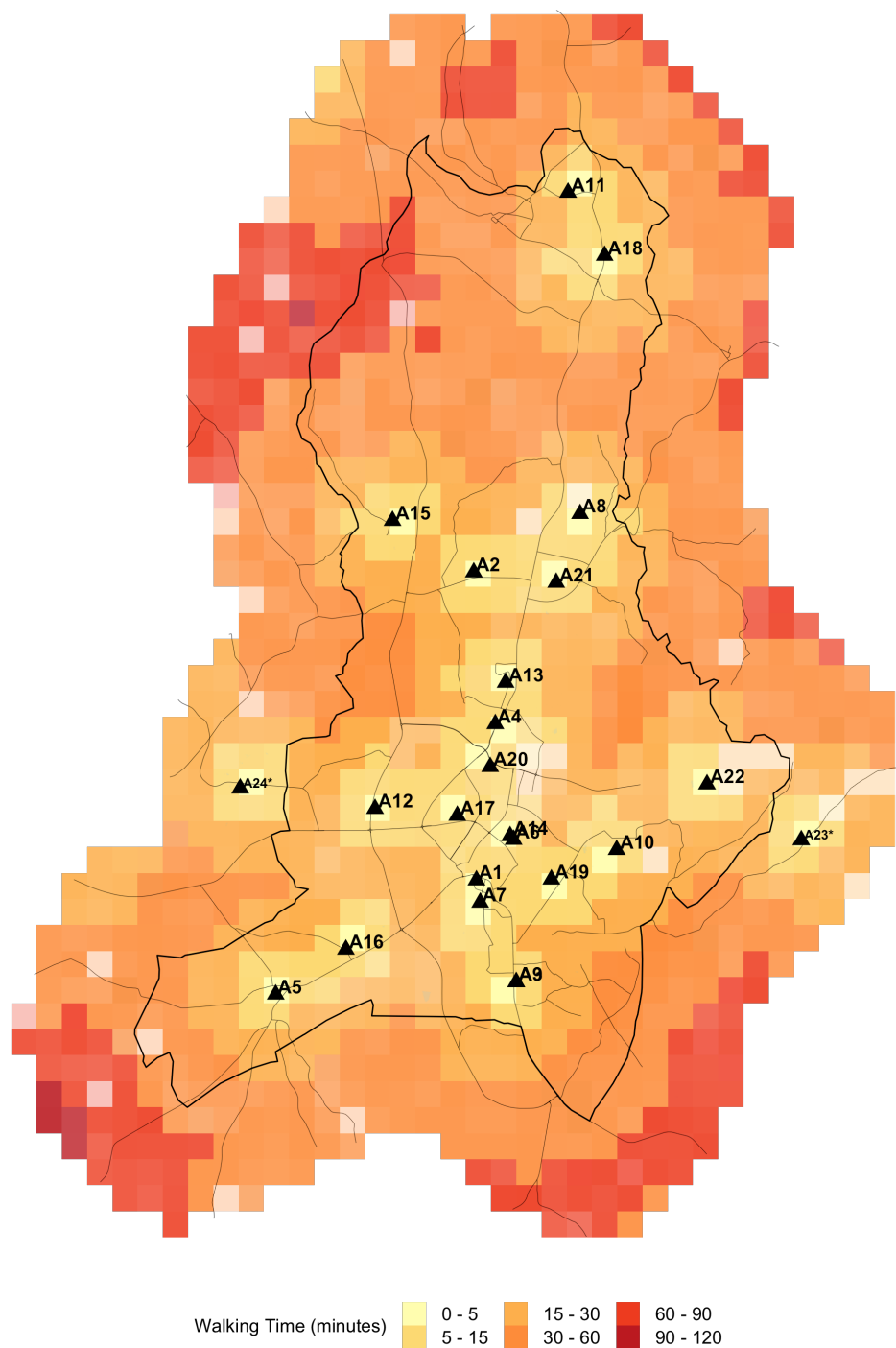


Figure 4: Estimated travel times to the closest ART facility. Travel times were calculated using data on road infrastructure, types of terrain and land elevation.

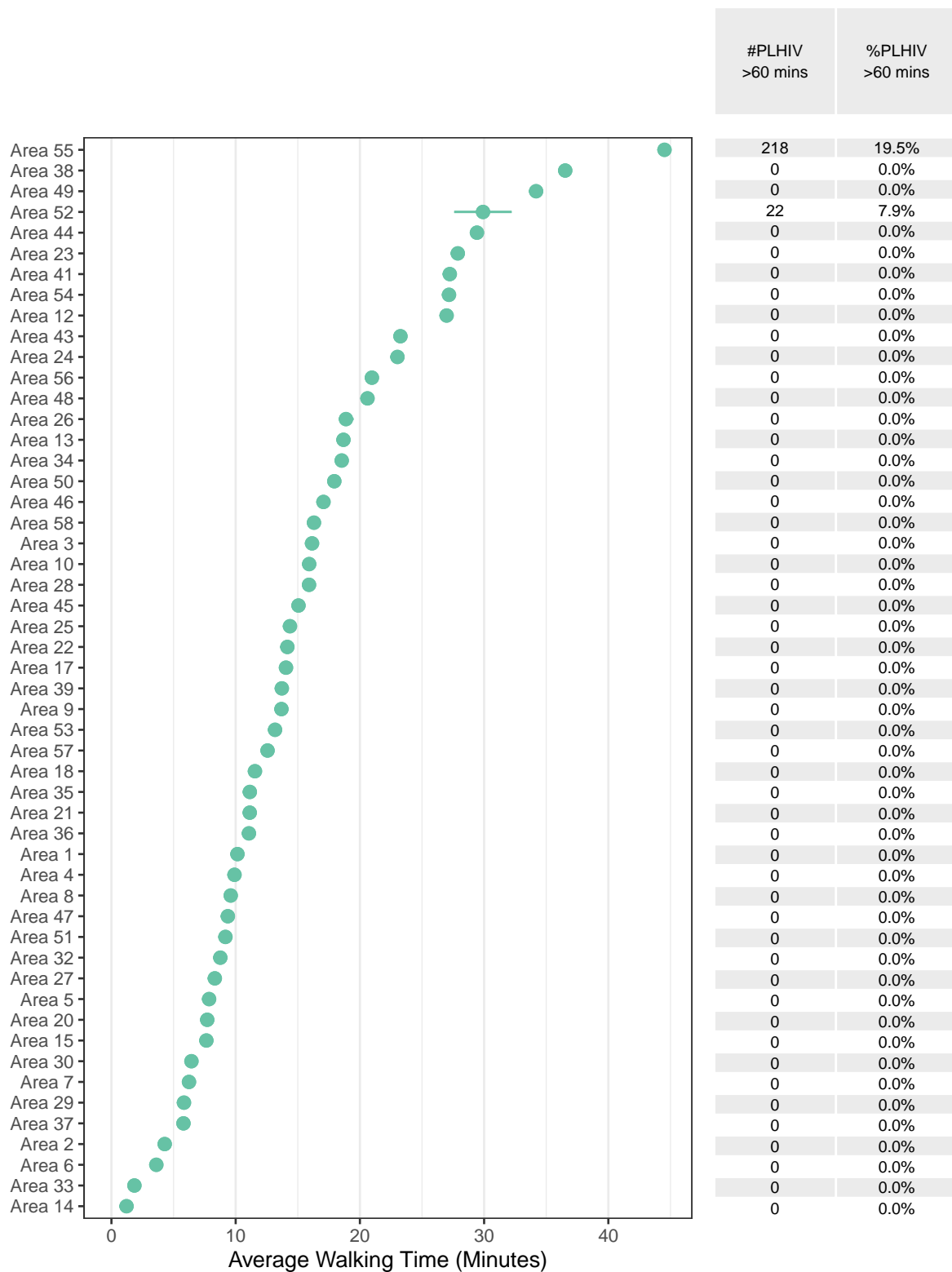


Figure 5: Estimated average walking time to the closest ART facility, weighted by the estimated number of PLHIV within the traditional authority. The right table indicates estimated number and proportion of PLHIV that need more than 60 minutes to travel to the closest ART facility, respectively.

## Areas outside 60 minutes travel

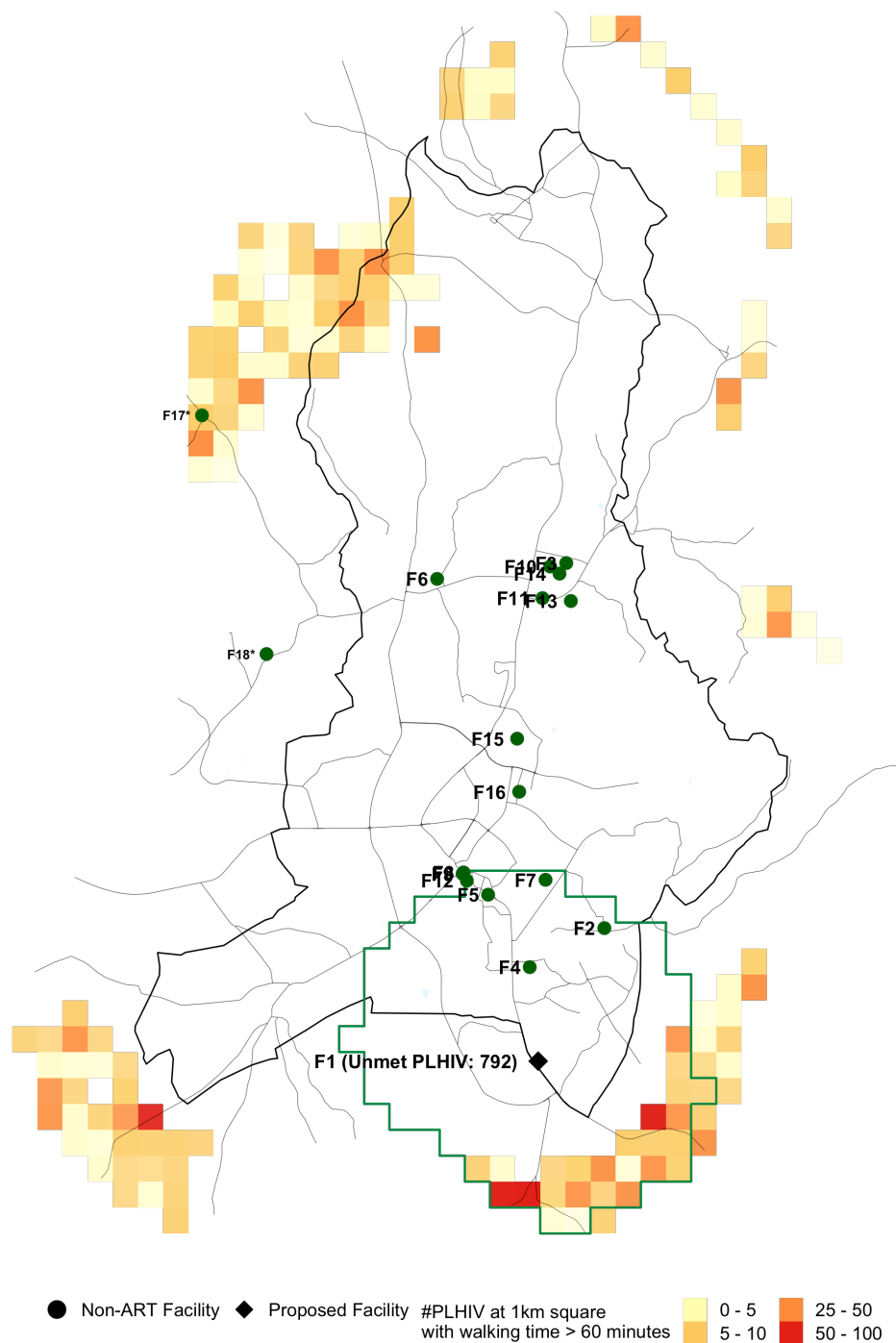


Figure 6: Proposed facility locations. Areas where the walking time to the closest ART facility is <60 minutes have been removed. Green lines indicate the 60-minutes catchment area of the proposed facility.

## Appendix (Methods Summary)

The analysis involved several steps:

1. **Creating a map of spatial prevalence by approximately 1km grid cells.** We used cluster-level survey data from the 2015/16 MDHS and MPHIA household surveys and HIV prevalence amongst ANC clients from routine health facility data to obtain a gridded PLHIV prevalence map (1km grid cells).
2. **Calculate the estimated number of PLHIV in each 1km grid cell.**
  - Modelled estimates of total population by 1km grid cell were sourced from the WorldPop project (<https://www.worldpop.org/geodata/summary?id=49698>). Gridded populations are constrained to only grid cells containing built settlements based on satellite imagery.
  - Gridded populations were adjusted to match traditional authority (TA) population data from the 2018 household census, projected forward to 2020 based on district population projections.
  - Gridded HIV prevalence (step 1) was multiplied by population for estimates of the distribution of PLHIV by 1km grid cell.
  - The gridded PLHIV in each district were scaled to align to total PLHIV in each district from the 2020 Naomi model estimates.
3. **Calculate walking travel time for PLHIV to existing ART services.** We used data on land cover terrain type (Global Land Cover 2000), roads (OpenStreetMap), elevation (GMTED2010), and water bodies (NASA Shuttle Radar Topography Mission) to model walking time from each grid cell to 757 public or not-for-profit health facilities providing ART services using the AccessMod software. Walking speed was assumed to be 6-7km/h on roads and 2-3 km/h on non-road surfaces.
4. **Analyse the number and locations of PLHIV residing greater than 60, 90, or 120 minutes walking time from existing ART facilities.** Grid cells were classified by the travel time to the nearest public or not-for-profit ART facility using the travel time model. Maps were filtered for PLHIV residing greater than 60, 90, or 120 minutes, thresholds of interest defined based on discussions with the Department of HIV and AIDS (DHA).
5. **Identify optimal locations to reach the most PLHIV who currently reside greater than 60 or 90 minutes from ART services.** An optimisation algorithm was implemented to systematically select the best facilities and locations where ART service delivery can be introduced to reach the most PLHIV residing outside travel time thresholds.

The list of 757 active facilities currently providing ART services was sourced from DHA-MIS database. Facilities that were private-for-profit were excluded from the analysis of travel time catchments. Health facilities which do not currently provide an ART service, which are candidate locations for expanding ART services, were sourced from facilities visited during the 2018/19 Service Availability and Readiness Assessment (SARA). Candidate facilities included existing health posts which are not staffed full time.