LOCATION ANALYSIS OF PRIVATE SCHOOLS: A MOVE TOWARDS DATA-DRIVEN INSIGHT

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ABSTRACT

The prudence with which facility siting decisions are made is often a key determinant of a business' relative success or demise. Ease of transport access often plays a cornerstone role in the school choice process and, accordingly, the selection of a particular site for a new school should be considered sagaciously to ensure acceptable accessibility for its target market. The research explored the use of a geographic information system (GIS) to perform various accessibility-based analyses to inform school site selection in the Cape Winelands Municipality. The research considered the perspective of a private-sector education provider aimed primarily at learners from higher household income backgrounds. The results of these analyses suggested that existing schools within the study area were well-positioned to serve the higher end of the market effectively, however, several sites were identified which would be accessible within 12 minutes driving time for a sufficient number of targeted learners to potentially render relatively small facilities (with capacities of approximately 200 learners) justifiable. As a result, it was suggested that a private education provider should either pursue one or more of the proposed sites in anticipation of future population growth or it should consider the possibility of acquiring existing facilities instead of Greenfield expansion.

1. INTRODUCTION

Of recent, South Africa's market for private basic education has experienced rapid development and a roaring rise in popularity. While total national basic education enrolments grew by 3.39 percent between 2009 and 2018, the number of learners attending private facilities ballooned by some 52.64 percent (Department of Basic Education, 2019a). This growing demand has underpinned the impressive expansion of private education chains such as Curro Holdings and ADvTECH Group, resulting in a rapid roll-out of new facilities across the country. This proliferation of independent schools generates benefits for the government by reducing the need for new state-provisioned facilities, providing welcomed relief for an under-strain public purse.

Location analysis attempts to encourage sagacity in siting decisions through the use of quantitative tools which typically aim to locate facilities optimally with consideration for aspects such as facility capacities, transport costs, limits on travel times and/or budgetary constraints (Francis, McGinnis & White, 1983). The adoption of location analysis principles, therefore, reduces the dependence upon intuition and qualitative information in location decisions. Prudent siting decisions which ensure accessibility for suitably large target markets may reduce the likelihood of facility underutilisation, consequently mitigating the risk exposure of education providers. Thorough location analysis should, accordingly, be a cornerstone in the expansion plans of these companies. Despite this, notably little literature on private school siting was publicly available, particularly in a South African context, thereby warranting an exploration of the siting decision from an accessibility perspective to provide decision support for education providers. Expressed formally, the aim of the study was to determine if- and where an independent provider of basic education should locate a combined school aimed primarily at learners from higher-income households within the Cape Winelands Municipality (CWM), based on the findings obtained through the use of GIS software, guided by the principle of maximising accessibility for acceptably large target markets. To achieve this, Flowmap (version 7.4), an open-source GIS package developed by the University of Utrecht's Faculty of Geographical Sciences, was used.

2. STUDY AREA

The CWM is comprised of 1 016 small areas[1]. At a local municipality level, 313 are found in Drakenstein, 232 in Stellenbosch, 185 in Breede Valley, 164 in Witzenberg and 122 in Langeberg (Statistics South Africa, 2011). Of the 160 695 learners enrolled in primary- and high schools within the region, 4 689 were enrolled in the region's 27 independent schools. Of these, 15 were ranked as quintile[2] five (Q5) schools and contributed 4 034 of the total learners. New higher-end private schools would likely face robust competition from a host of well-funded and acclaimed Q5 public facilities, such as Bloemhof, Paul Roos Gymnasium and Paarl Boys High School, which call the CWM home. The CWM's 54 Q5 public schools had a total of 34 497 enrolments (Department of Basic Education, 2019).

3. METHODOLOGY

Several analyses were undertaken, namely *unconstrained*- and *capacity-constrained catchment area analyses*, various *accessibility analyses* and *expansion modelling*. For these, three sets of data were required; *demand* (represented by the number of learners at their home locations), *supply* (represented by existing schools within the region) and a *digital road network*. Before beginning, considerable data preparation was required to adapt the available data to meet the requirements of the GIS package. Additionally, a series of assumptions and limitations had to be established due to the imperfect nature of the data. For example, the analyses were underpinned by the assumption of spatial rationality, meaning that learners would always attend the nearest school when all schools were judged to be of equal quality. Because the term "quality" is open to individual perception, particularly in an education setting, a universally available measure was needed as a proxy. It was decided that the school quintile rankings would serve this purpose.

Demand data, which allowed the demographic- and socio-economic composition of the study area to be explored, were obtained from the most recent population census. The 2011 Census CD was used to access the survey results at a small area level. An age breakdown of individuals living in each small area was obtained from the "Descriptive" census database. Only data relating to those aged 7-18 years were extracted, and these individuals were then categorised according to the school type that they were most likely to attend (i.e. ages 7-13: primary school; ages 14-18: secondary school). This implies that it was assumed that learners would start primary school in the year of their seventh birthday

[1] The creation of a small area layer (SAL) involves the addition of adjacent enumeration areas within the same sub-place which have populations fewer than 500 (Statistics South Africa, n.d.).

[2] The quintile system ranks all ordinary schools in South Africa on the basis of wealth, with the poorest category represented by quintile one and the least poor category represented by Q5. The first three quintiles have been declared no-fee schools, while the upper two quintiles may collect fees (Dass & Rinquest, 2017).

and complete their secondary education in the year of their 18th birthday. It was also assumed that learners would complete their primary phase education in seven years. Some inaccuracy may stem from learners starting school later than assumed or repeating grades while enrolled. Additionally, because the census survey was administered in October, 13-year-olds who would reach their 14th birthday later in the year would still be considered of primary school age, for example. Furthermore, the study included *all* individuals aged 7-18, meaning that no consideration was made for those unable to attend ordinary schools, such as those in need of specialised facilities. Alternative schooling options like distance learning and home-schooling were not considered. Owing to the relatively dated nature of the census data, it was deemed beneficial to make adjustments to the observed population sizes. This was achieved by applying the estimated annual population growth rates[3] experienced by each of the CWD's local municipalities between 2011 and 2016 to all their respective small areas. It was further assumed that these rates would remain the same from 2016 to 2019.

The number of households within each small area was extracted from the "Head of Household" census database. It was assumed that learners from households with an annual income of R307 601 or more would form the target market for schools at the higher end of the market. While the study focused on the top end of the market, *some* Q5 schools would also have enrolments from middle-income backgrounds. It was hence decided that the main target market for these facilities would be learners from households with an annual income of R76 401 or more. Because data relating to household income and age were acquired from separate databases, ascertaining the household income bracket which each individual belonged to was not possible. As a result, an estimate of the number of individuals in each income bracket had to be made for each age category on a small area basis. This was achieved by multiplying the proportion of households within each income bracket in a specific small area by the number of individuals within each age group in the same small area, implying that consideration was not given to household sizes and that individuals were simply placed into income brackets according to the same distribution as households.

Before performing the analyses, the distance between each possible origin-destination pair had to be reflected in a *distance matrix*. In rural areas, where car usage is less common, it may be preferable to create this matrix using Euclidean distances. The CWM is, however, covered relatively well by roads, thereby rendering the use of a digital road network more appropriate for this purpose. Additionally, the CWM is influenced strongly by geographical features which prevent direct travel. When creating the distance matrix, consideration was included for roads which do not allow bi-directional travel, as well as for land adjacent to major roadways which would not necessarily be directly accessible from these roadways due to factors such as high speed limits, roadside barriers and road elevations, for example. It was assumed that all learners would travel to school as passengers in cars.

Despite some small areas within the study area being home to dense populations, others were relatively sparse due to their less-urbanised nature. As a result, a collection of relatively large small areas existed. These areas were often poorly served by roads, leading to large parcels of inaccessible land which would be unideal for school siting. To overcome this, the relatively large small areas were split into a series of thiessen polygons, each of which would be easily accessible by road. To determine which small areas should be divided into smaller units, the study area was overlaid with hexagons, each with a two-kilometre diameter. Instances where more than half of the area of two or more hexagons

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[3] Witzenberg: 2.37%, Drakenstein: 2.20%, Stellenbosch: 2.25%, Breede Valley: 1.14%, Langeberg: 1.53% (Cape Winelands District Municipality, 2019).

fell within a given small area resulted in the small area being divided. As a result, the study area was split into 4 799 units. This meant that an assumption had to be made as to how the population of each split small area should be distributed among its respective thiessen polygons. This was achieved by creating a new variable, which was calculated by dividing the size of each polygon by the size of its corresponding small area. This variable was then multiplied by the population size of each small area to obtain an estimated population for each polygon.

Supply data were acquired from the Western Cape School Masterlist, a freely available database of both public- and private schools, produced by the Department of Basic Education. A host of variables is provided for each school, including its name, phase(s) of education offered, coordinates, quintile and the number of enrolments. At the time of the study, the dataset was most recently updated in April 2019. In the few cases where multiple Q5 schools were located in a given geographic unit, the schools were treated collectively as a "cluster" with their capacities combined. The CWM was treated in isolation, meaning that it was assumed that learners residing inside the study area would not attend facilities outside of the CWM and that learners residing outside the study area would not attend facilities within the CWM, even if these were the closest facilities available.

3.1 Unconstrained Catchment Area Analyses

Flowmap's catchment area analysis tool allocates demand from each origin to its nearest destination facility, thereby allowing estimates of the existing relationships between origins and destinations to be made – making it a useful tool for identifying pockets of potential demand for new facilities. Two variables are required for this type of analysis; a *weight* variable (represented by the number of targeted students in each geographical unit) and a *capacity* variable. In the unconstrained scenario, an artificial capacity of 99 999 was imposed on each school. This allowed a "best case" scenario to be modelled, which allocated demand purely on the basis of accessibility. No lower bound was placed on enrolments, meaning that some facilities would be allocated unsustainably few students. In reality, some Q5 schools would have enrolments from outside of the higher-end target market prioritised in this analysis, meaning that schools which may appear to have unsustainably few enrolments may be justifiable if learners from a wider range of wealth backgrounds are included. Facilities which received numerous enrolments in this analysis could, however, be ideally situated for serving the higher end of the market exclusively. Initially, learners aged 7-13 were allocated to existing primary-, intermediate- and combined schools, while learners aged 14-18 were allocated to existing secondary- and combined schools. This was followed by an additional analysis which considered both age categories collectively.

3.2 Capacity Constrained Catchment Area Analyses

When using Flowmap's catchment area analysis tool, limits on travel time can be specified and unique capacities can be assigned to each facility, thereby allowing constraints to be applied when modelling. In this analysis, capacities were placed on each existing facility. The existing number of enrolments in each facility was used as proxy for capacity, as the actual capacities were not included in the Schools Masterlist. This meant that Q5 schools in the region had an assumed collective capacity of 38 531 learners. Because some Q5 schools undoubtedly enrol learners from lower household income brackets than those targeted by top-end facilities, this analysis included individuals from mid-to-high income backgrounds. This resulted in 50 624 learners being included in the assumed target market. As in the unconstrained case, the primary- and high school categories were initially considered separately before combining the groups in an additional analysis.

3.3 Accessibility Analyses

Flowmap contains an array of tools for performing accessibility analyses. One such tool is used to calculate the *threshold distance,* which refers to the minimum distance around a given site which would result in a specified number of targeted individuals being reached (De Jong & Van Der Vaart, 2013). Put differently, this might answer the question, "What is the minimum driving time required before 500 targeted individuals would be able to access the facility?" Three related threshold distance analyses were performed, subsequently allowing suitability maps to be created based on accessibility for specific target markets. These analyses considered all learners aged 7-18 collectively, implying that the possibility of combined (primary- and high school) facilities was investigated. Each analysis initially considered a threshold capacity of 500 targeted learners, however, the results obtained using this parameter necessitated the analyses to be repeated with a smaller threshold capacity. For the second round of analyses, the threshold capacity was set to 200 learners.

The first analysis aimed to identify areas which could be reached by an adequate number of learners from mid-to-high income backgrounds within 12 minutes of driving. The second analysis related specifically to the higher end of the market by only including learners from households with an annual income of R307 601 or more. It was assumed that the higher-end target market would be more discerning when selecting a school, and hence be willing to tolerate longer travel times to attend schools which meet their needs. Accordingly, the acceptable travel time was set to 30 minutes. The final analysis was performed as a consequence of the results obtained in the constrained catchment area analysis. In the constrained catchment area analysis, a large number of students from the mid-to-high income target market *could not* be allocated to Q5 schools because the size of the market far exceeded the combined capacity of these schools. Among those who *could* be allocated to a school, some faced relatively long school commutes (exceeding 12 minutes), representing a group of learners that might be willing to swap facilities if a nearer alternative were to open. Within these two groups of learners, some were from wealthier backgrounds, and these learners represented an ideal market for a higher-end private education provider to consider targeting with a new facility. It was hence decided to investigate if enough of these learners resided in high enough concentrations to justify new schools.

3.4 Expansion Modelling

Flowmap includes a variety of tools for service location modelling, each suitable for different purposes. One such tool is the expansion model, which aims to find the most suitable locations for new facilities based on any of six possible target functions (De Jong & Van Der Vaart, 2013). While the results obtained in the accessibility analyses outlined above yielded underwhelming results when a threshold capacity of 500 learners was considered, adjusting this to 200 learners yielded more encouraging results. An inspection of figure 5 would indicate that several locations would be acceptably accessible for at least 200 learners from wealthier backgrounds who were either not allocated- or were allocated but faced fairly long travel times when the constrained catchment area analysis was performed. These locations could be identified broadly by inspection of the suitability map, however, using the expansion model with the equivalent parameters to those used when creating this figure would allow the most appropriate areas to be pinpointed with ease, as well as allow precedence to be determined among the identified areas. The *minimise individual customer distance* target function was specified, which successively identifies sites which allow a specified number of targeted individuals to be reached within the shortest possible travel time. Since a portion of the targeted learners would have to be distance-sensitive to consider switching to a new facility (i.e. those allocated in the constrained catchment area analysis with a travel time exceeding 12 minutes), the model was set to stop once travel times reached 12 minutes. Because of the model's greedy nature (i.e. after the first site suggestion, each subsequent iteration may affect the optimality of preceding sites), the possibility of one-step optimality was accounted for by testing the solution with an *expansion and relocation* model.

4. RESULTS

4.1 Unconstrained Catchment Area Analyses

The mapped results of the unconstrained catchment area analyses explained in section 3.1 are presented in figure 1 below. In these figures, the locations of existing Q5 schools are indicated with bars, with larger bars indicative of more learner allocations. Yellow shading was used to show geographical units which were home to students who could reach appropriate schools within relatively short travel times, while darker shading was used to represent regions with poorer access. Grey shading was indicative of regions which were not home to any appropriately-aged learners from higher-income backgrounds. The accessibility statistics obtained from these analyses are presented in Table 1 below.

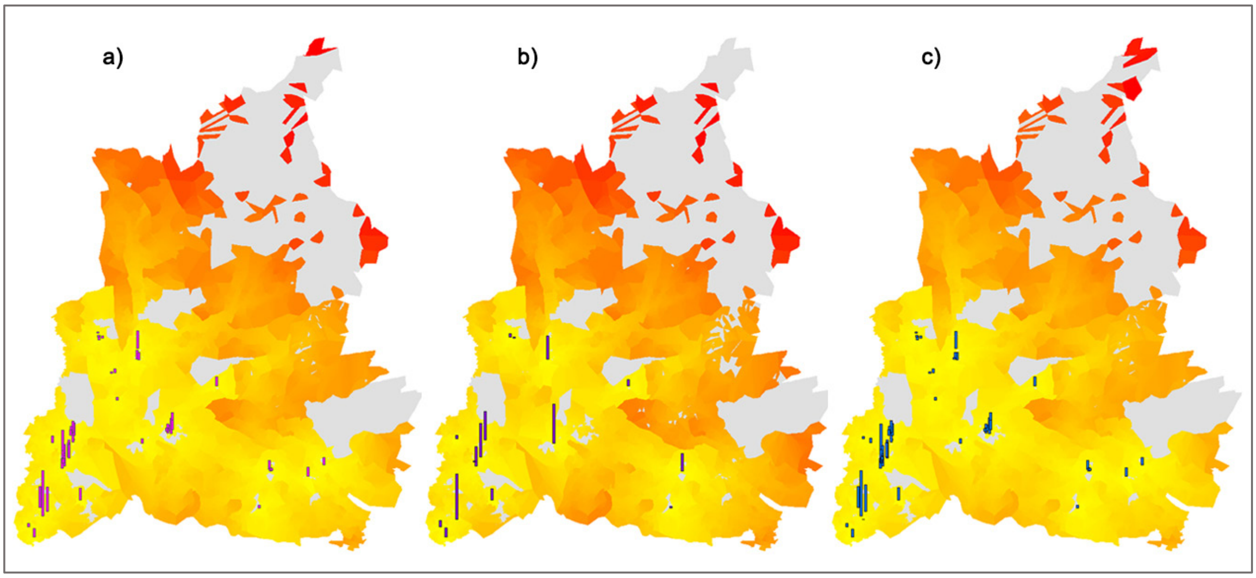

Figure 1: Unconstrained catchment area analysis results for all individuals from higher household income backgrounds aged a) 7-13, b) 14-18, c) 7-18

Table 1: Unconstrained catchment area analyses- accessibility statistics

	Approximate travel time (seconds)		
Cumulative percentage	**7-13 year-olds**	**14-18 year-olds**	**7-18 year-olds**
25	116	253	113
50	201	419	188
75	428	868	380
90	819	1184	801
Worst-case travel time	8 934	8 558	10 037
Average travel time	379	619	362

When all learners from wealthier backgrounds were assigned to their nearest school, learners aged 14-18 faced significantly longer school commutes than those aged 7-13. This was not unexpected, as many more Q5 facilities which offered primary school education existed in the region. On average, schools which offered primary phase education were allocated just 139 learners from wealthier backgrounds – only just exceeding the 135-learner requirement for small state-provisioned primary schools (Department of Basic Education, 2012). Many of these facilities would hence require enrolments from a wider range of income backgrounds to remain sustainable. The most allocations received by a single primary school was 701, suggesting that this facility was well-positioned for serving the top end of the market. In the case of schools which offered secondary phase tuition, nine schools met the minimum requirement for high schools of 200, while eight fell short and would likely require enrolments from a wider range of wealth backgrounds. The most allocations received by a secondary phase facility was 925. When all targeted learners were considered collectively and allocated without consideration for the phases that the schools actually served, average enrolments reached 239. In this scenario, 24 facilities were allocated fewer than 135 learners, while the most enrolments allocated to a single facility was 1 263.

4.2 Capacity Constrained Catchment Area Analyses

Figure 2 provides the mapped results of the constrained catchment area analysis. Yellow shading was used to indicate relatively good accessibility for learners from mid-to-high income backgrounds, while darker shading was indicative of poorer accessibility. Because the target market exceeded the capacity available in this analysis, learners who lived relatively far away from a school were not allocated. Regions which were not served were shaded in grey. Fewer regions were left unserved when learners aged 7-13 were considered than when those aged 14-18 were considered, owing to Q5 primary schools having a much larger combined capacity than Q5 high schools. Intuitively, the schools which received the most enrolments and had the smallest catchment areas were located in the most urbanised areas within the study area, including Stellenbosch, Paarl, Wellington and Worcester. A summary of the accessibility statistics obtained from this analysis is presented in table 2. Based on the worst-case travel times, one can deduce that high schools were constrained more firmly by their capacities than primary schools, resulting in smaller catchment areas.

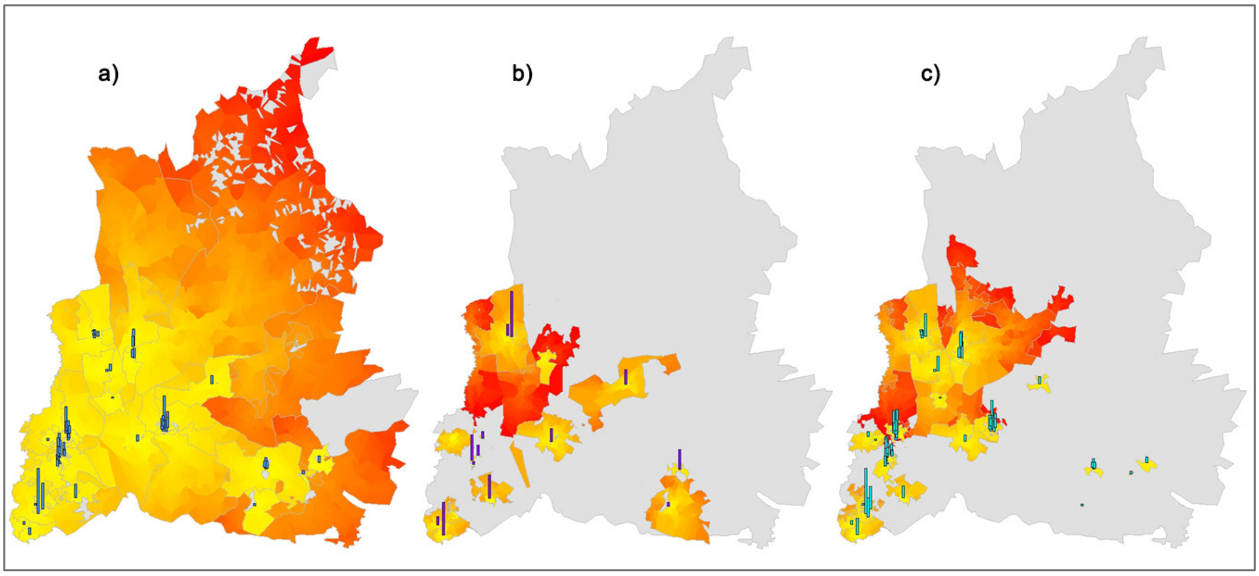

Figure 2: Capacity-constrained catchment area analysis results for all individuals from higher household income backgrounds aged a) 7-13; b) 14-18; c)7-18

Table 2: Constrained catchment area analyses- accessibility statistics

	Approximate travel time (seconds)		
Cumulative percentage	**7-13 year-olds**	**14-18 year-olds**	**7-18 year-olds**
25	130	222	107
50	267	491	203
75	494	865	389
90	1 049	1688	779
Worst-case travel time	9 299	2 518	3 110
Average travel time	537	657	394

4.3 Accessibility Analyses

The suitability maps produced in the first accessibility analysis (which included all learners from mid-to-high income backgrounds) are presented in figure 3 below. In these maps, existing Q5 schools are indicated by blue markers, while grey shading was used to show which areas would not be reachable for an adequate number of targeted learners within 12 minutes of driving. Yellow shading was used to show areas which could be accessed by enough learners within the given timeframe, while darker shading was used to identify areas which could be reached by enough learners within the shortest timeframe. The mapped results showed that existing Q5 schools were located in relatively accessible areas (i.e. areas with darker shading) for the mid-to-high household income target market.

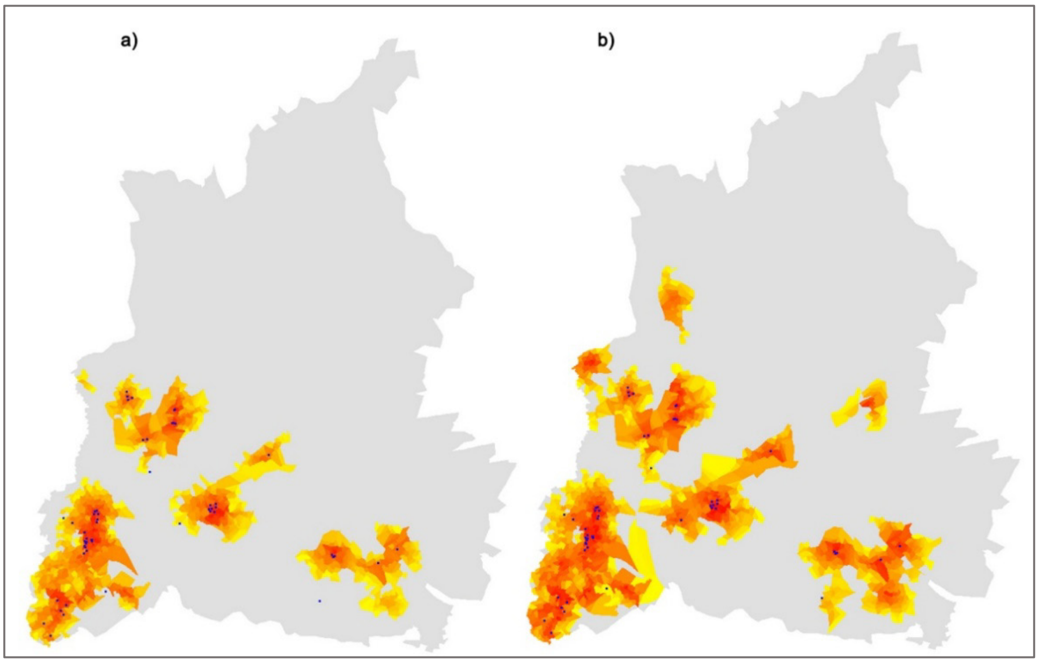

Figure 3: Suitability map for areas which could be accessed within 12 minutes of driving by a) 500 and b) 200 learners from mid-to-high household income backgrounds

The mapped results of the accessibility analysis which only considered learners from the higher-end target market are presented in Figure 4, with black markers used to indicate the locations of existing Q5 schools. These maps include two layers of gradient shading so that the relative accessibility of all areas is clearly visible. In the first layer, yellow shading was used to indicate areas which could be reached by an adequate number of targeted learners within 30 minutes, while darker shading was used to indicate more accessible regions. In the second layer, areas which could be reached by enough targeted learners within 12 minutes were shaded pink, while blue shading was used to identify the areas with the shortest threshold distances. As was the case in the first accessibility analysis, existing Q5 facilities appeared to be sited ideally for serving the target market.

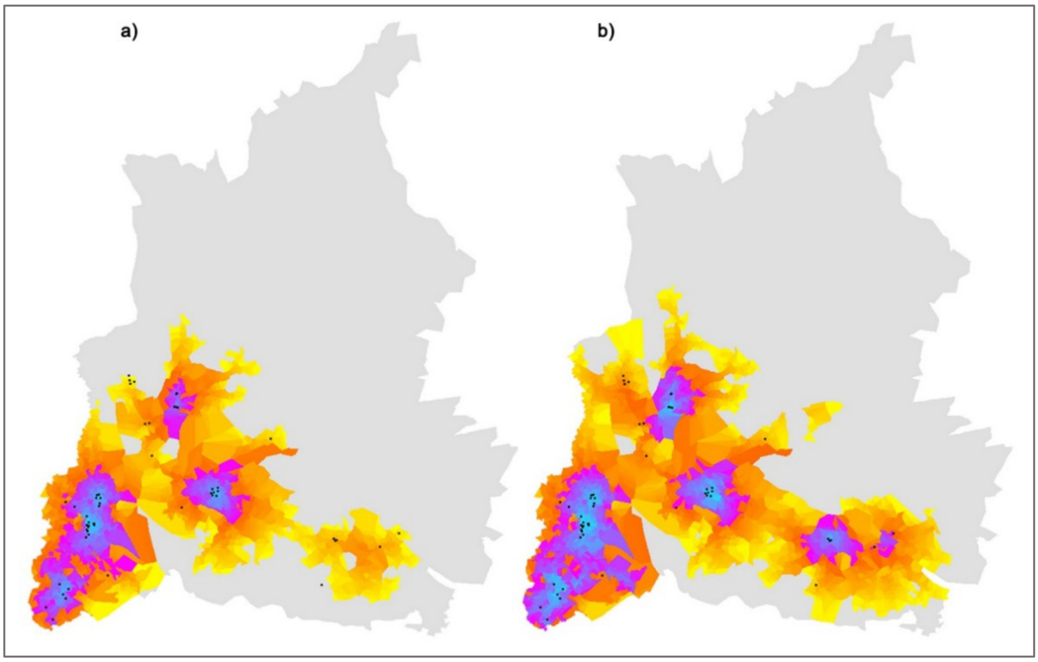

Figure 4: Suitability map for areas which could be accessed within 30 minutes of driving by a) 500 and b) 200 learners from higher household income backgrounds

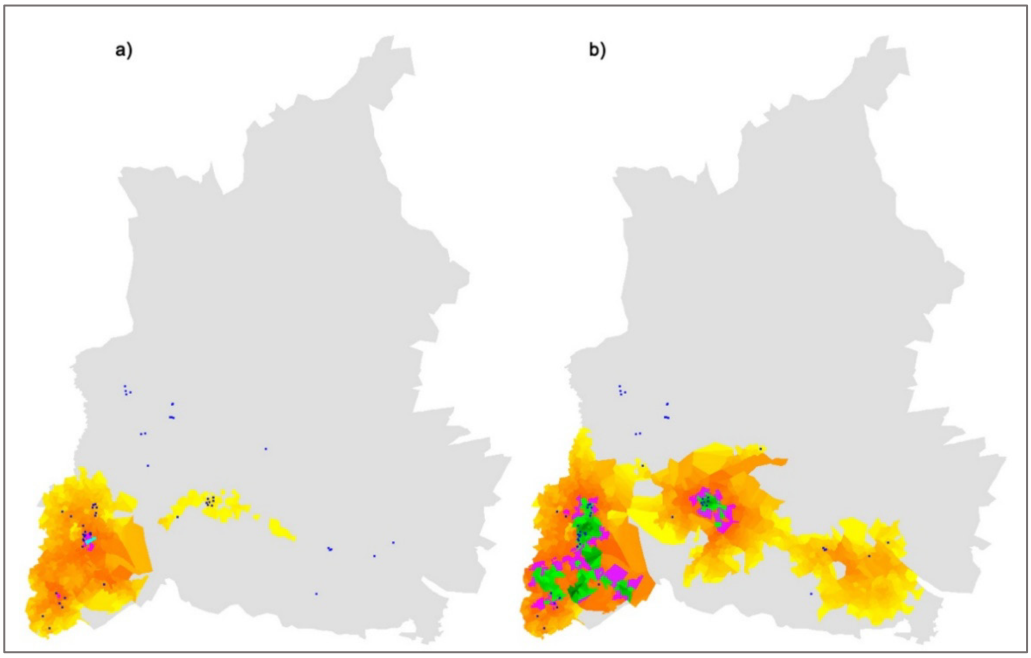

Figure 5: Suitability map for areas which could be accessed by a) 500 and b) 200 learners from higher income backgrounds who were either not allocated in the constrained catchment area analysis or were allocated but would face long school commutes

Figure 5 (above) presents the suitability maps produced in the final accessibility analysis, which included learners from wealthier households who were either not allocated in the constrained catchment area analysis or were allocated but faced travel times exceeding 12 minutes. In the first of these maps, yellow shading was used to represent regions which could be reached by 500 targeted learners within 30 minutes, while darker shading was used to indicate shorter threshold distances. Pink shading was used to show the 14 geographical units which could be reached by 500 targeted learners within 12 minutes, while bright blue was used to highlight the single unit, located in the Paarl SP2 Small Place, which could be reached by 500 targeted learners within ten minutes. This analysis would suggest that the most accessible areas for serving the top end of the market were already occupied by existing Q5 facilities, thereby signalling that the market was all but entirely saturated. From the perspective of accessibility alone, it is hence likely that planting a combined school with a capacity of 500 learners aimed at the top end of the market within the CWM would represent a strategy fraught with risk. As a result, new facilities tailored to the top end of the market within this region would likely have to compete with existing facilities based on factors other than accessibility, such as teaching quality, facilities and curriculum offered.

In the second map, yellow shading showed areas which would be accessible to 200 targeted students within 30 minutes of driving, while progressively darker shading was used to indicate improved threshold distances. The 668 units which were accessible to 200 targeted learners within 12 minutes were shaded pink. Of these units, 478 would be reachable within ten minutes, with darker shades of green used to identify units with the shortest threshold distances. From an accessibility perspective, these dark green areas may represent the most ideal locations for new higher-end combined schools with capacities of 200 learners.

4.4 Expansion Modelling

The expansion model described in section 3.4 concluded after eight sites were proposed. Because all of these sites were found in the south-western reaches of the study area, only this region was shown in the mapped results of the analysis – presented in Figure 6. The proposed sites remained unchanged when the expansion and relocation model was run, indicating that the greedy nature of the expansion model did not result in one-step optimality.

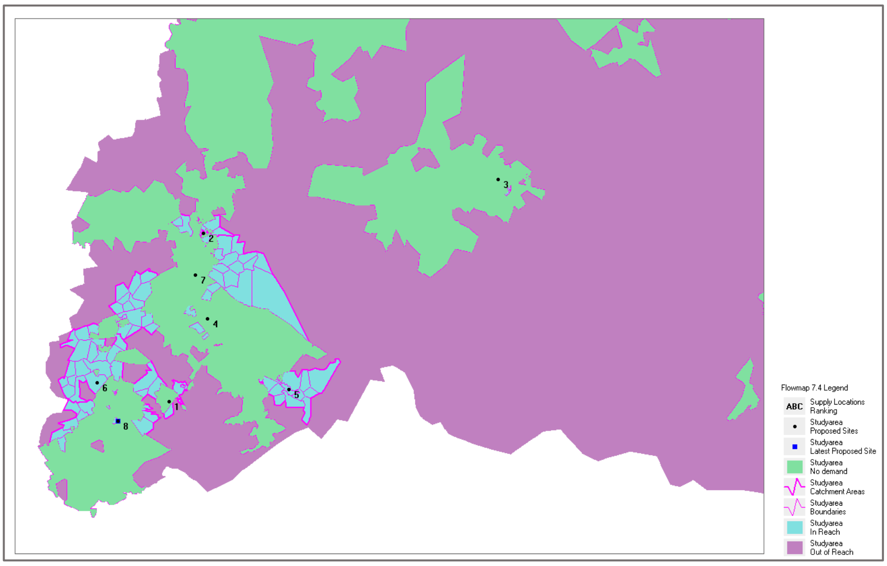

Figure 6: Results of the expansion model with a maximum travel time of 12 minutes

Table 3 provides the names of the small place, main place and local municipality which each of the proposed sites are located within.

Table 3: Description of the locations of the sites proposed by the expansion model

Site Ranking	Geographical unit	SAL Code	Small Place Name	Main Place Name	Local Municipality
1	11586	1670003	Stellenbosch NU	Stellenbosch NU	Stellenbosch
2	1660187	1660187	Groenheuwel	Paarl	Drakenstein
3	1680143	1680143	Worcester Central	Worcester	Breede Valley
4	12023	1660297	Drakenstein NU	Drakenstein NU	Drakenstein
5	1670213	1670213	Hugenote	Franschhoek	Stellenbosch
6	10730	1670201	Stellenbosch NU	Stellenbosch NU	Stellenbosch
7	11884	1660255	Paarl SP2	Paarl	Drakenstein
8	1670095	1670095	Stellenbosch SP	Stellenbosch	Stellenbosch

A total of 3 455 targeted learners were identified across 2 611 client locations. Table 4 shows the cumulative number of these client locations which would be served if each of the proposed sites were to be selected in the suggested order. This table clearly illustrates differences in the relative concentrations of targeted individuals between the proposed sites. For example, the first-ranked site was accessible to 200 targeted learners in less than four minutes, while the eighth-ranked site had a threshold distance close to the 12-minute limit. It is important to recall that distance-sensitivity played a key role when defining the target market assumed for this analysis, meaning that the proposed sites with threshold distances just shy of 12 minutes may not, in fact, offer significant accessibility advantages over the facilities which these learners were allocated to in the constrained catchment area analysis.

Table 4: Selected results of the expansion model

Location ranking	Number of client locations fully served	Threshold distance to new supply location (seconds)
1	2 197	237.5338
2	2 223	303.2114
3	2 231	310.8985
4	2 235	370.8337
5	2 258	414.8767
6	2 282	483.5385
7	2 324	629.587
8	2 339	702.4009

5. CONCLUSIONS

The results obtained from the analyses undertaken point towards a higher-end market which is already well-served by existing Q5 schools, meaning that new facilities would likely face firm competition within the CWM. Only one geographical unit out of 4 799 was found to be accessible within ten minutes of driving to 500 learners from higher household income backgrounds who were either unallocated- or allocated but faced relatively long journeys to existing schools when the constrained catchment area analysis was undertaken. Reducing the threshold to 200 learners from the same target market resulted in several hundred geographical units being within reach in an acceptable timeframe. To establish priority among these potential pockets of demand, an expansion model was used, resulting in eight proposed locations which would minimise the individual travel distance for 200 targeted learners and would not require any learners to travel for longer than 12 minutes. Based on the results obtained, the adoption of one of two broad strategies is suggested for private education providers that are interested in serving the top end of the market within the CWM:

- Plant a new, relatively small combined school in one of the locations proposed in Table 3 in anticipation of future population growth in- and around the selected area.
- Consider the possibility of acquiring an existing facility with either a proven track record or growth potential instead of pursuing greenfield development.

6. SCOPE FOR FURTHER RESEARCH

Due to the inflexible requirements of the GIS software used and the imperfect nature of the data obtained, noteworthy assumptions were made before the analyses could be performed. Each of these assumptions presents opportunities for refinements to be made to the methodology. For example, using population data at an enumeration area level (rather than small areas) may represent an improved starting point for splitting the study area into smaller geographical units. Repeating the analyses after the completion of the 2021 census may also yield more accurate results. Alternatively, a more thorough approach to updating the population data, such as the cohort-component methodology, might be considered. Since one of the strategies suggested involved planting new schools in anticipation of population growth, forecasts of how the population distribution may change over time could be incorporated into further research. Because there is an inherent time lag between acquiring land and launching a facility for operation, it may also be worth including younger learners as part of the target market for new schools. It is also not uncommon for private education providers to offer facilities for pre-school children on the same sites as their primary- or combined schools. Because the Schools Masterlist dataset did not include data beyond the scope of basic education, this younger target market was not included in the analyses.

Because school quintile was used as a proxy for quality, it is likely that schools which would not compete directly for the top end of the market were included in the analyses. Further research might attempt to identify a smaller set of direct competitors through the creation of a more well-rounded measure of quality, thereby allowing the constrained catchment area analysis to be repeated with exclusive consideration for learners from wealthier backgrounds, as opposed to including all learners from mid-to-high income backgrounds.

While the analyses viewed the siting decision from an accessibility perspective, it is vitally important to consider an array of other qualitative factors, such as the availability-, affordability- and appropriateness of land before a siting decision is ultimately made.

Despite the study's focus on an isolated study area, the techniques employed could be adjusted with ease for use in other parts of South Africa. The private sector has seen its footprint in the education market balloon of recent and, as such, its role has become increasingly important. Research aimed at mitigating the risks faced by the country's private education providers could assist in maintaining the sector's upward trajectory, thereby allowing schools to focus on what matters most – aiding learners to reach their full potential.

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