

**GREEN CHAIR PROJECT  
“SWEETER DREAMS” BEDS PROGRAM  
NEEDS ANALYSIS**

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**Date:  
May 15, 2019**

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**GREEN CHAIR PROJECT  
“SWEETER DREAMS” BEDS PROGRAM  
NEEDS ANALYSIS, SPRING 2019**

**EXECUTIVE SUMMARY**

We estimate that, currently, more than 6,300 school-age individuals in Wake County do not have a bed of their own.

The poverty rate for Wake County is 8.9 percent. There are roughly 430,000 “household units” in Wake County, with an average size of roughly 2.5 persons per unit. This suggests that 38,270 households are below the federal poverty line, and 95,408 out of 1.072 million Wake County residents live in households classified as being below the federal poverty line.

Of the Wake County population, 18.7 percent are of school age, which means that 17,841 school-age children in Wake County live in households below the federal poverty line.

Thus, roughly 36 percent of the poor school-age children in Wake County do not have a bed of their own in which to sleep on a regular basis.

Among the Wake County Public School System population, we estimate that 5,376 students do not have a bed of their own. This is, roughly, 1 out of every 30 students.

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## ISSUE

It is well known among scholars who study the impact of sleep on health and human performance that, in general, a good night's sleep is positively associated with improved performance and better health outcome.<sup>2</sup> This correlation applies to children as well as adults, and, as reported by Gruber et al. (2014), the effect is particularly acute with respect to student performance in school.<sup>3</sup>

According to the National Sleep Foundation:

To thrive academically, kids of all ages—preschool through college—need to have energy, the ability to focus, concentrate, retain information, and be creative problem solvers. Success at school also requires kids to control impulses and manage emotions and behavior to keep on track. All of these skills depend heavily on healthy, consistent sleep.<sup>4</sup>

In August 2012, the Green Chair Project (henceforth GCP) initiated its “Sweeter Dreams” Bed Program to address this issue. Since the program began, GCP has distributed more than 2,300 beds in Wake County through its partner agencies and, in particular, the Wake County Public School System (henceforth WCPSS).<sup>5</sup>

GCP asked the authors of this report to study the impact of the Bed Program on the performance of the students who have received beds. While that research remains a work

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<sup>2</sup> For an accessible recent summary of the issue, see Walker (2017).

<sup>3</sup> Gruber et al. find that, among the academic areas they studied, performance in math and languages is particularly sensitive to sleep deprivation.

<sup>4</sup> <https://www.sleepfoundation.org/excessive-sleepiness/performance/improve-your-childs-school-performance-good-nights-sleep>

<sup>5</sup> GCP Bed Program Database, accessed March 4, 2019.

in progress, this report estimates the on-going needs of the Wake County school-age population (henceforth WCSAP) with respect to beds.

Despite the efforts of the GCP staff, the need for beds has continued to grow. In what follows, we review a previous report on the Bed Program, including a set of needs estimates; we update that report and offer a model for estimating the current need; we describe the data used to estimate the need; we report the results of our estimates and subject them to a set of sensitivity tests; and we draw specific conclusions from the study.

## **PRIOR RESEARCH**

This report updates a previous report commissioned by GCP during the spring of 2016. That report, entitled “‘Sweeter Dreams’ Bed Program Market Analysis,” provided the first estimates of the need for beds among the WCSAP; however, it focused exclusively on WCPSS students (Chlebowski et al., 2016).

The GCP distributes many of its beds directly through the on-site social workers in the WCPSS. Using GCP data, the authors of that earlier report estimated the ratio of students served per school social worker. To obtain their estimate of the unmet need for beds, the authors then, in essence, extrapolated the data collected from households served by GCP in the bed program to the rest of the WCPSS. The estimates omitted non-WCPSS households.

The estimates of the unmet need among WCPSS student, reported in Chlebowski et al., ranged from a low of 4,665 to a high of 9,730.

In the next section, we describe the model we use to estimate the need for beds among the WCSAP.

## MODEL

In this section, we offer a model for estimating the current need for beds among the WCSAP. Our objective is to account for both the beds that have already been distributed by GCP and the growth in the need for beds over time. The basic framework is captured by:

$$(1) \quad N_{t+n} = O_t - B_{t,t+n} + G_{t,t+n}$$

where  $N_{t+n}$  is the current need for beds among the WCSAP.  $O_t$  is the previous estimate of needed beds at time  $t$ , which in this case was the spring of 2016.  $B_{t,t+n}$  is the number of beds distributed by GCP during period  $n$ , which is between spring 2016 and the present; and  $G_{t,t+n}$  is the increase in the need for beds since period  $t$ .

In other words, the current need ( $N$ ) is simply the old need ( $O$ ), minus the number of beds previously distributed ( $B$ ), plus the growth in need ( $G$ ).

As noted above, the initial estimates of the unmet need are from Chlebowski et al. The figures ranged from a low of 4,665 to a high of 9,730. To obtain their estimates, Chlebowski et al. extrapolated the student-school social worker ratio for the schools that actively sought GCP beds to the rest of the WCPSS. While this was a legitimate approach to the problem, one could argue that the population in need was greater among the schools with social workers who actively worked in conjunction with GCP. This

insight would lead us to give more credibility to the Chlebowski et al. lower-bound estimate than the upper-bound figure.

In addition, the earlier estimates reflected only the needs of the WCPSS population. While this population represents a substantial proportion of the WCSAP – 80 percent, according to Wake County (2019b) – the non-WCPSS population is substantial, roughly 40,000 students.

Considering these two factors, we derive our previous estimate of need,  $O_t$ , by weighting the Chlebowski et al. “low” estimate more heavily than their “high” estimate.<sup>6</sup> Thus,

$$(2) \quad O_t = [\beta \text{Low} + (1 - \beta) \text{High}] / 0.80, \text{ where } \beta = 0.90$$

Which yields our estimate of the previous need for beds, where, by previous, we mean at the time of the original Chlebowski et al. report.<sup>7</sup>

As for the number of beds distributed since the Chlebowski et al. report,  $B_{t,t+n}$ , we simply rely on the GCP “Sweeter Dreams” Bed Program Database.

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<sup>6</sup> While the weighting is admittedly somewhat arbitrary, this approach has the advantage of biasing downward the subsequent estimates so that this report does not risk inflating the “true” need.

<sup>7</sup> The estimate is divided by 0.80, because Chlebowski et al. only estimated the need for WCPSS students, who makeup only 80 percent of the WCSAP (WCPSS 2019).

The growth in the need for new beds, since the Chlebowski et al. report, is based on our estimates of several components:

$$(3) \quad G_{t,t+n} = \Phi[L + (\zeta Z(P - L))]D$$

where  $P$  is the average daily number of (net) migrants into Wake County, including live births.  $L$  is the average daily number of live births in Wake County.  $\zeta$  is the school-age share of the 0-19-age population.  $Z$  is the 0-19-age share of the Wake County population.  $\Phi$  is the long-run equilibrium share of the WCSAP that would be without a bed, in the absence of the GCP bed program; and  $D$  is the number of days since the previous report.

So substituting (2) and (3) into (1) yields:

$$(4) \quad N_{t+n} = \{[\beta \text{Low} + (1 - \beta) \text{High}]/0.80\} - B_{t,t+n} + \{\Phi[L + (\zeta Z(P - L))]D\}$$

Equation (4) gives us the current estimate of the need for beds among the WCSAP.

In the next section, we describe the data we used to estimate (4).

## DATA

The data used in equation (4) and the sources from which we obtained them are as follow:

The previous estimate of the need for beds at time  $t$ ,  $\mathbf{O}_t$  is from Chlebowski et al. (2016). The weights on the “high” and “low” estimates –  $\mathbf{B}$  and  $(\mathbf{1} - \mathbf{B})$ , respectively – in equation (2) are 0.90 and 0.10. As we explain above, the lower-bound estimate from Chlebowski et al. is probably closer to the “true” figure. Therefore, a weighted estimate, with the heavier weight on the lower-bound, seems appropriate here.

The number of beds distributed since the Chlebowski et al. report,  $\mathbf{B}_{t,t+n}$ , is from the GCP “Sweeter Dreams” Bed Program Database.

As for the components of  $\mathbf{G}_{t,t+n}$ , the average daily growth of the Wake County population,  $\mathbf{P}$ , and the average daily number of live births in Wake County,  $\mathbf{L}$ , are from Goldsmith (2019).

$\Phi$ , the long-run equilibrium share of the WCSAP without a bed in the absence of any intervention, comes from recent, though somewhat conflicting, estimates of the poverty rate in Wake County. The “official” figure is currently 8.9 percent (Wake County 2019c). However, according to Kneebone and Murray (2016, Appendix), the poverty rate in 2015 was 11.6 percent, suggesting a substantial reduction in the rate in just three

years, and Kneebone and Murray report that the long-run average annual compounded rate of growth of Raleigh’s “poor population,” a broader measure of need, is 6.6 percent. Extrapolating that figure from 2016 to 2019, suggests that  $\Phi$  should be 1.19 times the 2016 figure. However, that would make our benchmark estimate much too high by any reasonable standard. To avoid this problem and to avoid biasing upward our needs estimate; we settled on 50 percent of the poverty rate for  $\Phi$ , which would be consistent with the mid-range needs estimate implied by the figures in Chlebowski et al. (2016). In the sensitivity analysis below, we explore an alternative scenario, one with a value of  $\Phi$  closer to that implied by the Kneebone-Murray measure of need.

The school-age share of the 0-19-age population,  $\zeta$ , and the 0-19-age share of the Wake County population,  $Z$ , are from Wake County (2019a).

Finally,  $D$ , the number of days since the previous report, corresponds with the date of the previous report, which was spring of 2016, and the end of the current school year, June 2019.

# RESULTS

Table 1 reports the values for each of the variables in the model.

**Table 1**

**Variables Used to Estimate the Current Need for Beds among the WCSAP**

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$$O_t = \beta \text{Low} + (1 - \beta) \text{High} = \{[0.90(4,665)] + [0.10(9,730)]\} / 0.80 = 6,464$$

$$B_{t,t+n} = 1,557$$

$$P = 64$$

$$L = 21$$

$$\Phi = 0.50 \times 0.89 = 0.0445$$

$$\zeta = 0.737$$

$$Z = 0.288$$

$$D = 3 \times 365 = 1,095$$

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Sources: See Data section, above.

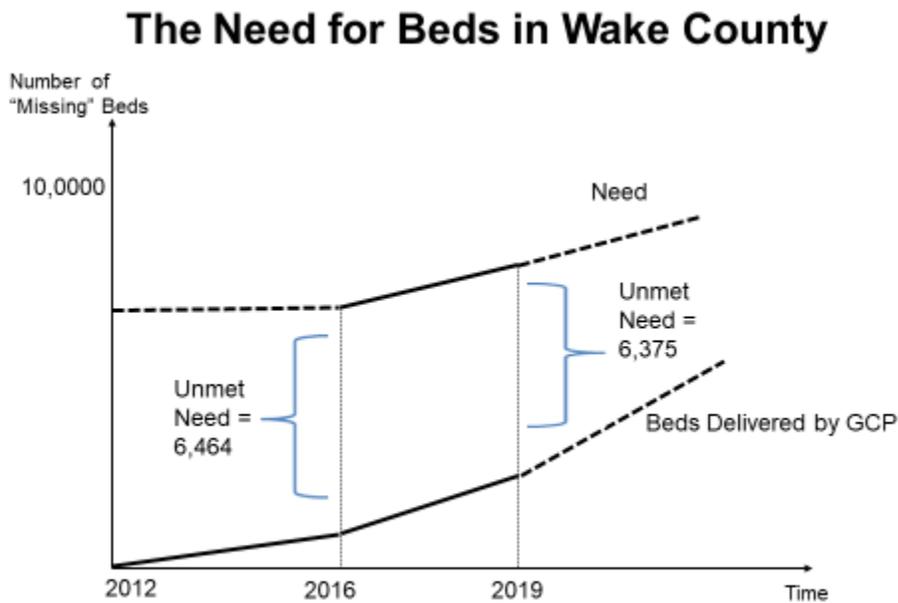
Substituting the values in Table 1 into Equation (4) yields.

$$\begin{aligned} N_{t+n} &= \{[\beta \text{Low} + (1 - \beta) \text{High}] / 0.80\} - B_{t,t+n} + \{\Phi[L + (\zeta Z(P - L))]D\} \\ &= \{[0.90(4,665)] + [0.10(9,730)]\} / 0.80 - 1,557 + \{[0.0445[21 + (0.737 \times 0.288(64 - 21))]1,095\} \\ &= 6,464 - 1,557 + 1,468 \end{aligned}$$

$$N_{t+n} = 6,375$$

Thus, we estimate that, currently, 6,375 school-age individuals in Wake County do not have a bed of their own.

So another way to think about this estimate is three years ago, there were 6,464 children among the WCSAP without a bed of their own. In the subsequent three years, GCP supplied 1,557 of those individuals with beds. However, during that three-year period, the WCSAP population without a bed increased by 1,468 individuals. Thus, while the GCP “Sweeter Dreams” program has made a noticeable difference in the need for beds, that need continues to be substantial. The figure below captures the situation.



Also, as noted above, the poverty rate for Wake County is 8.9 percent. There are roughly 430,000 (1.072 mil/2.5) “household units” in Wake County; with a poverty rate of 8.9 percent, this suggests that 38,270 households are below the federal poverty line.

Thus 95,408 out 1.072 million people live in households that are classified as being below the federal poverty line ( $1.072 \times 0.089$ ). Of the Wake County population, 18.7 percent is of school age (WCPSS 2019), which means that 17,841 ( $0.187 \times 95,408$ ) school-age children in Wake County live in households below the federal poverty line.

Thus, roughly 36 percent of the poor school-age children in Wake County do not have a bed of their own in which to sleep on a regular basis.

## SENSITIVITY ANALYSIS

In this section, we consider alternative scenarios to test the sensitivity of our estimate to the assumptions we make in deriving it.

The first alternative scenario we consider reflects the uncertainty surrounding the initial need-for-beds estimates from the Chlebowski et al. (2016). Following are concern that the lower-bound estimate was closer to the true estimate, we initially set  $\beta$  at 0.90.

Suppose, even that figure was too low. To test the sensitivity of  $\beta$ , we re-estimated the model setting  $\beta$  at 1.00. In other words, we use the lower-bound estimate from Chlebowski et al. Table 2, below, contains the results of our alternative scenarios. The first column contains the benchmark or base scenario estimates and parameter values. Changing  $\beta$  leads to a decrease in the initial needs estimate by roughly 600 beds, and thus the current need decreases by roughly 600 beds.

The second alternative scenario involves  $\Phi$ , the share of the current the WCSAP without beds. Recall that, deferring to information we obtained from other sources, we argued that the share should be in the neighborhood of 50 percent of the poverty rate. Suppose this figure is too low; suppose that the “true” figure were 60 percent. We re-estimated the model setting  $\Phi$  at 60 percent of the poverty rate, and that increases the current need to 6,669 beds (column 3, in Table 2).

Finally, to this point we have focused on the entire WCSAP; however, in our third alternative scenario we focus only on WCPSS students, who represent 80 percent of the WCSAP (Wake County 2019b). The result is shown in column four of Table 2. Removing non-WCPSS individuals from the estimate decreases the needs figure to 5,376. This is, roughly, 1 out of every 30 students – i.e. 5,376/160,470 – where the enrollment figure is from Wake County Public School System (2019).

**Table 2**  
**Needs Estimates, with Alternative Parameters**

	<b>Base Scenario</b>	<b>Lower Initial Need Scenario</b>	<b>Higher Poverty Rate Scenario</b>	<b>WCPSS-Only Scenario</b>
$O_t =$	6,464	<b>5,831</b>	6,464	<b>5,172</b>
$B_{t,t+n} =$	1,557	1,557	1,557	1,557
$P =$	64	64	64	64
$L =$	21	21	21	21
$\Phi =$	0.0445	0.0445	<b>0.0534</b>	<b>0.0534</b>
$\zeta =$	0.737	0.737	0.737	0.737
$Z =$	0.288	0.288	0.288	0.288
$D =$	1,095	1,095	1,095	1,095
$N =$	6,375	<b>5,742</b>	<b>6,669</b>	<b>5,376</b>

Sources: See explanation in text.

## CONCLUSIONS

Given the discussion and results reported above, we feel comfortable drawing the following conclusions.

1. Currently, more than 6,300 school-age children in the Wake County do not have a bed of their own. This figure represents 36 percent of the children living in households below the poverty line.
2. A set of reasonable alternative scenarios generated estimates in the range from roughly 5,700 to 6,700 beds; thus, we feel comfortable with a figure of 6,300 as a reasonable estimate of the need for beds.
3. Among the WCPSS population, we estimate that 5,376 students do not have a bed of their own in which to sleep on a regular basis. This is, roughly, 1 out of every 30 students.

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