

REPORT

525 – 565 CONESTOGO ROAD

WATERLOO, ON

PEDESTRIAN WIND ASSESSMENT

PROJECT #2002470

MARCH 27, 2023



SUBMITTED TO

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1. INTRODUCTION



Rowan Williams Davies & Irwin Inc. (RWDI) was retained by GSP Group Inc. to conduct a qualitative desktop wind assessment for the proposed development at 525-565 Conestogo Road in Waterloo, Ontario (see **Image 1**). This assessment is in support of the Site Plan Application as required by the City of Waterloo.

This assessment was based on the following:

- a review of regional long-term meteorological data from Waterloo-Wellington International Airport;
- design drawings received from Turner Fleischer Architects Inc. in January and February 2023;
- wind-tunnel studies undertaken by RWDI for similar projects in the Kitchener Waterloo area;
- our engineering judgement and knowledge of wind flows around buildings¹⁻³; and,
- The use of 3D software developed by RWDI (*WindEstimator*²) for estimating the potential wind conditions around generalized building forms.

This approach provides a screening-level estimation of potential wind conditions. Conceptual wind control measures to improve wind comfort are recommended, where necessary. To confirm and quantify these wind conditions, refine wind control measures and address phasing, physical scale-model tests are recommended.

Note that other wind issues, such as those related to wind loading, stack effect, air quality, snow accumulations, door operability, solar glare, etc., were not considered in the scope of this assessment.



Image 1: Aerial View of Existing Site and Surrounding (courtesy of Google™ Earth)

1. H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering and Industrial Aerodynamics*, vol.104-106, pp.397-407.
2. H. Wu, C.J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004*, Nashville, Tennessee.
3. C.J. Williams, H. Wu, W.F. Waechter and H.A. Baker (1999), "Experience with Remedial Solutions to Control Pedestrian Wind Problems", *10th International Conference on Wind Engineering*, Copenhagen, Denmark.

2. BUILDING AND SITE INFORMATION



The proposed development is located on Conestogo Road, south of Northfield Drive West and east of Conestoga Parkway in Waterloo, Ontario. The immediate surroundings are mostly low-rise commercial or industrial buildings. Downtown Waterloo is located approximately four kilometers to the south-southeast and Waterloo -Wellington International Airport is approximately 13 kilometers to the southeast.

The project involves the development of 13 towers, ranging in height from 14 to 35 storeys, on the north part of the site and four buildings of three storeys on the south part. Pedestrian areas of interest include the main lobby entrances, adjacent sidewalks/walkways, central park and amenity areas on podium roofs. **Images 2 and 3** show a rendered view of the proposed development and the site plan, respectively.



Image 2: Project Rendering



Image 3: Site Plan Identifying Entrances and Central Park

► Lobby Entrance

3. WIND DATA



Meteorological data from Waterloo-Wellington International Airport recorded between 1991 and 2021 were used as reference for wind conditions. This is the nearest station to the project site with long-term wind data.

The distributions of wind frequency and directionality for summer (May through October) and winter (November through April) seasons are shown by the wind roses in **Image 4**.

When all winds are considered (regardless of speed), winds from the south-southwest, through northwest and east directions are predominant during both summer and winter.

Strong winds of a mean speed greater than 30 km/h measured at the airport (at an anemometer height of 10 m) occur more often in the winter than in the summer.

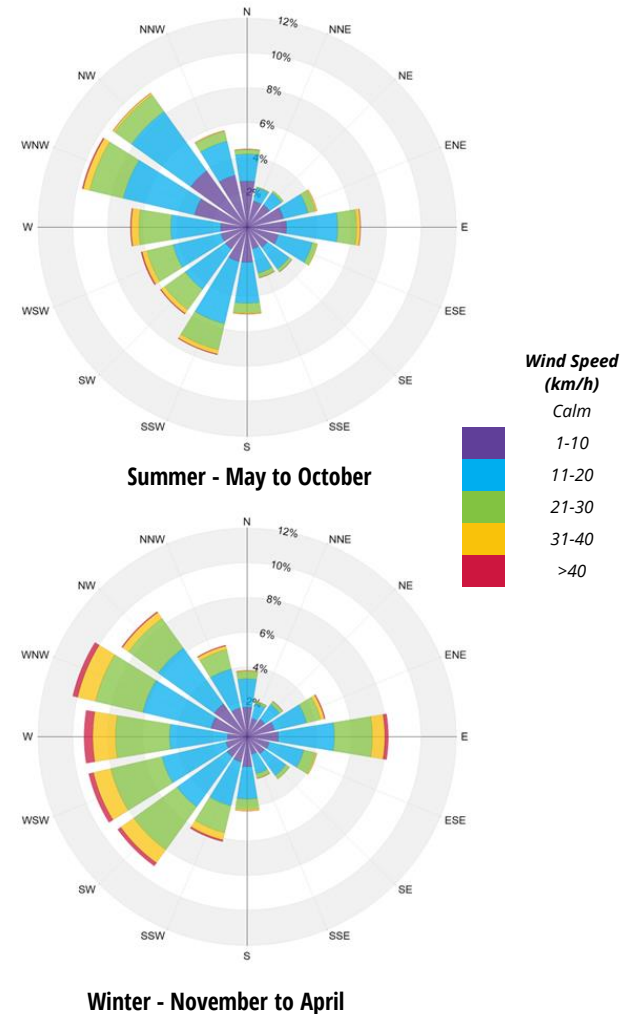


Image 4: Directional Distribution of Winds Approaching Waterloo-Wellington International Airport (1991 – 2021)

4. CRITERIA



The RWDI pedestrian wind criteria are used in the current study. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities and by the building design and city planning community including the City of Waterloo. The criteria are as follows:

4.1 Pedestrian Safety

Pedestrian safety is associated with excessive gust wind speeds that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (**90 km/h**) occur more than 0.1% of the time or 9 hours per year, the wind conditions are considered severe.

4.2 Pedestrian Comfort

Wind comfort can be categorized by typical pedestrian activities:

Sitting (≤ 10 km/h): Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.

Standing (≤ 14 km/h): Gentle breezes suitable for main building entrances and bus stops.

Strolling (≤ 17 km/h): Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.

Walking (≤ 20 km/h): Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.

Uncomfortable: None of the comfort categories are met.

Wind conditions are considered suitable for *sitting*, *standing*, *strolling* or *walking* if the associated mean wind speeds are expected for at least four out of five days (80% of the time). Wind control measures are typically required at locations where winds are rated as *uncomfortable* or if they exceed the wind safety criterion.

Note that these wind speeds are assessed at the pedestrian height (i.e., 1.5 m above grade or the concerned floor level), typically lower than those recorded in the airport (10 m height and open terrain).

These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

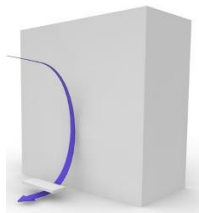
For the current development, wind speeds comfortable for *walking* or *strolling* are appropriate for the sidewalks/walkways; and lower wind speeds comfortable for *standing* are required for building entrances where pedestrians may linger. *Sitting / standing* conditions are preferable for outdoor areas like the central park and podium roof amenity areas during the summer.

5. PEDESTRIAN WIND CONDITIONS



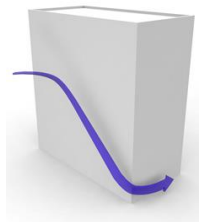
5.1 Background

In our discussion of wind conditions on and around the proposed project, reference may be made to the following generalized wind flows (see **Image 5**). If these building / wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and *uncomfortable* conditions.



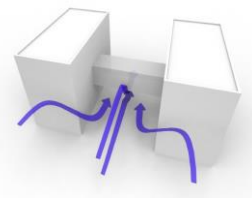
Downwashing

Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. This is often the main cause for wind accelerations around large buildings at the pedestrian level.



Corner Acceleration

Winds approach at an oblique angle to a tall façade and are deflected down causing a localized increase in the wind activity or corner acceleration around the exposed building corner(s) at pedestrian level.



Channelling

When two buildings are situated side by side or an underpass is created, wind flow tends to accelerate through the space due to channelling effect caused by the narrow gap.

Image 5: Generalized Wind Flows

Design details such as; setting back a tall tower from the edges of a podium, deep canopies close to ground level, wind screens / tall trees with dense landscaping, etc. (**Image 6**) can help reduce wind speeds. The choice and effectiveness of these measures would depend on the exposure and orientation of the site with respect to the prevailing wind directions and the size and massing of the proposed buildings.

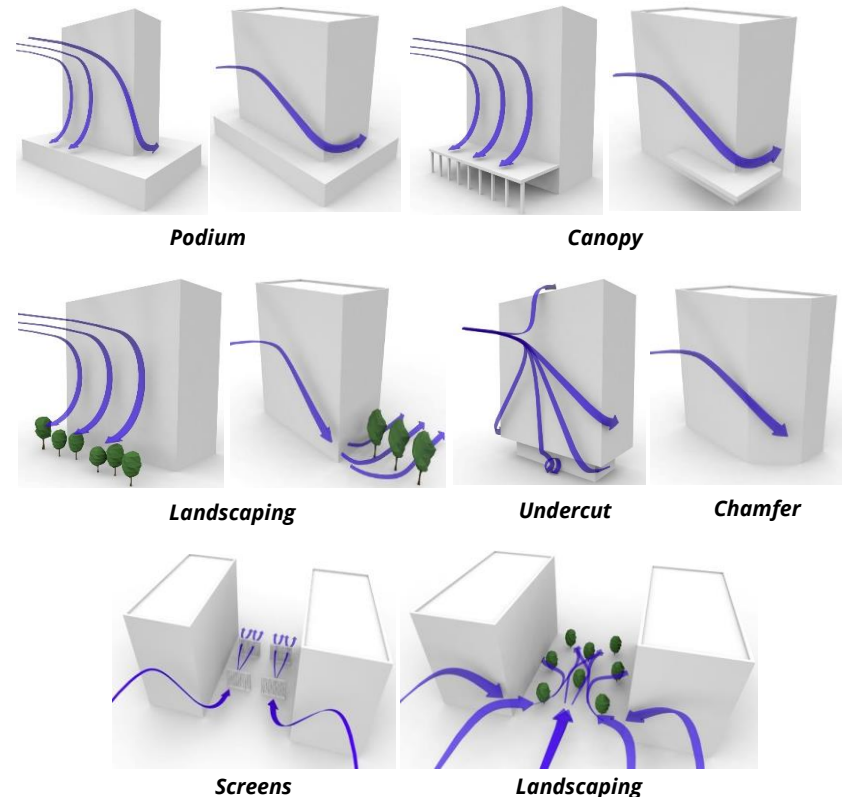


Image 6: Examples of Common Wind Control Measures

5. PEDESTRIAN WIND CONDITIONS



5.2 Existing Conditions

Wind conditions around the existing site are most likely comfortable for *standing* in summer and *strolling* in winter. No exceedances of the wind safety criterion are likely to exist.

5.3 Proposed Conditions

The proposed towers are significantly taller than the existing buildings on the site and the surrounding structures. As such, they will intercept stronger winds at upper levels and encourage them to flow toward grade level (see **Image 5**). North and west towers share a large two-storey podium which is considered a wind-responsive design. The rest of the towers on the east and south are also equipped with five-storey podiums. The podiums help deflect the downwashing winds away from the ground level, hence moderate the wind impact of tall towers (see **Image 6**). The podium roofs, however, will be exposed to the wind downdrafts and experience high wind activity. Channelling of the westerly winds between the towers will also create high-wind zones along the gaps between west towers (see **Image 5**).

The predicted summer and winter wind comfort conditions for the proposed configuration are presented in **Images 7** and **8**, respectively. The results are focused on building entrances, sidewalks/walkways around the site, park and podium roofs. The following text discusses the highlights of the expected wind conditions.

5.3.1 Sidewalks and Surrounding Areas

The addition of the proposed project to the site is not expected to have significant impact on the existing wind conditions in the surrounding areas. In fact, the tall towers will provide sheltering from the predominant westerly winds for the areas to the east.

Due to the mitigative impact of podiums, wind speeds on the surrounding sidewalks/walkways/trails are expected to be generally comfortable for strolling, walking or calmer all year round. Increased wind speeds and potentially uncomfortable conditions are predicted near the northeast (retail square) and southwest corners of the block occupied by the towers and between the east towers. The pedestrian wind safety criterion may also be exceeded at these areas during the winter months.

Reduced wind speeds at these areas can be achieved through introduction of large canopies wrapping around the windy corners. Any use of landscaping and/or porous screens at the windy corners and along the gaps between the east towers can help provide local sheltering and protect the downwind areas. To extend the wind benefits of landscaping to the colder months of the year, the use of coniferous or marcescent species, which retain their foliage all year round, is recommended. In **Image 9**, examples of the use of such measures are presented.

5. PEDESTRIAN WIND CONDITIONS



5.3.2 Entrances

The main lobby entrances are shown in **Image 3**. Most of the entrances are situated in recessed areas which is positive. Nevertheless, these entrances will be subject to winds downwashing off the tall tower facades. The resultant wind speeds are expected to be comfortable for strolling or walking throughout the year and are considered higher than ideal. Entrances of the northeast and southeast towers are expected to experience higher wind speeds, due to direct exposure to winds accelerating between buildings. Wind conditions at the entrances of the east towers are expected to be comfortable for the intended use.

Design team may consider the use of large canopies above the entrances, recessing them behind their respective facades or installing planters/screens on both sides of the doors to create a sheltered doorway (see **Image 10** for examples).

5.3.3 Central Park and Roof Decks

The central park is protected from the prevailing winds by the surrounding towers and podiums, which is positive. However, westerly winds channelling between the west towers can reach the park and increase the wind activity on the west part of the park to levels above those suitable for passive use. In the summer season, when outdoor areas are typically in use, the conditions are expected to be comfortable for sitting or standing at most areas. To mitigate these conditions, the

design team is considering the implementation of landscaping throughout the park area, particularly at the west end. In the winter, due to the seasonally stronger winds, increased wind speeds are predicted in the park, with potentially uncomfortable conditions at the west end. These conditions will be improved with the addition of landscaping should it be of the coniferous or marcescent variety.

Wind conditions that are higher than those conducive to passive use are predicted at various areas on the podium roofs. The design team is planning to mitigate the wind conditions in areas that are planned as gathering spaces by implementing soft and hard landscaping features. Note that higher wind speeds and potentially uncomfortable conditions and safety exceedances are expected on the podium roofs during the winter. If outdoor areas are not planned to be accessible during the winter, such high wind speeds may be considered acceptable. In **Image 10**, examples of the use of wind control features on outdoor areas are presented as reference.

RWDI is working with the design team to implement the required mitigation strategies as the design evolves. The effectiveness of these measures should/will be quantified with wind tunnel testing at an appropriate time. This testing will also investigate the phasing of the development to determine the wind conditions during interim stages.

5. PEDESTRIAN WIND CONDITIONS



- Predicted *SUMMER*
Wind Conditions**
- Sitting / Standing
 - Strolling / Walking
 - Uncomfortable

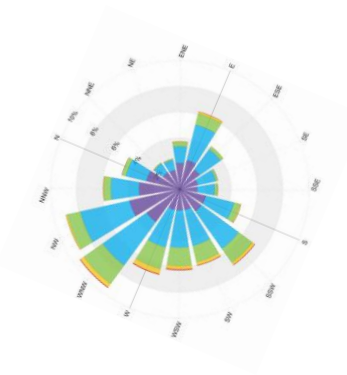
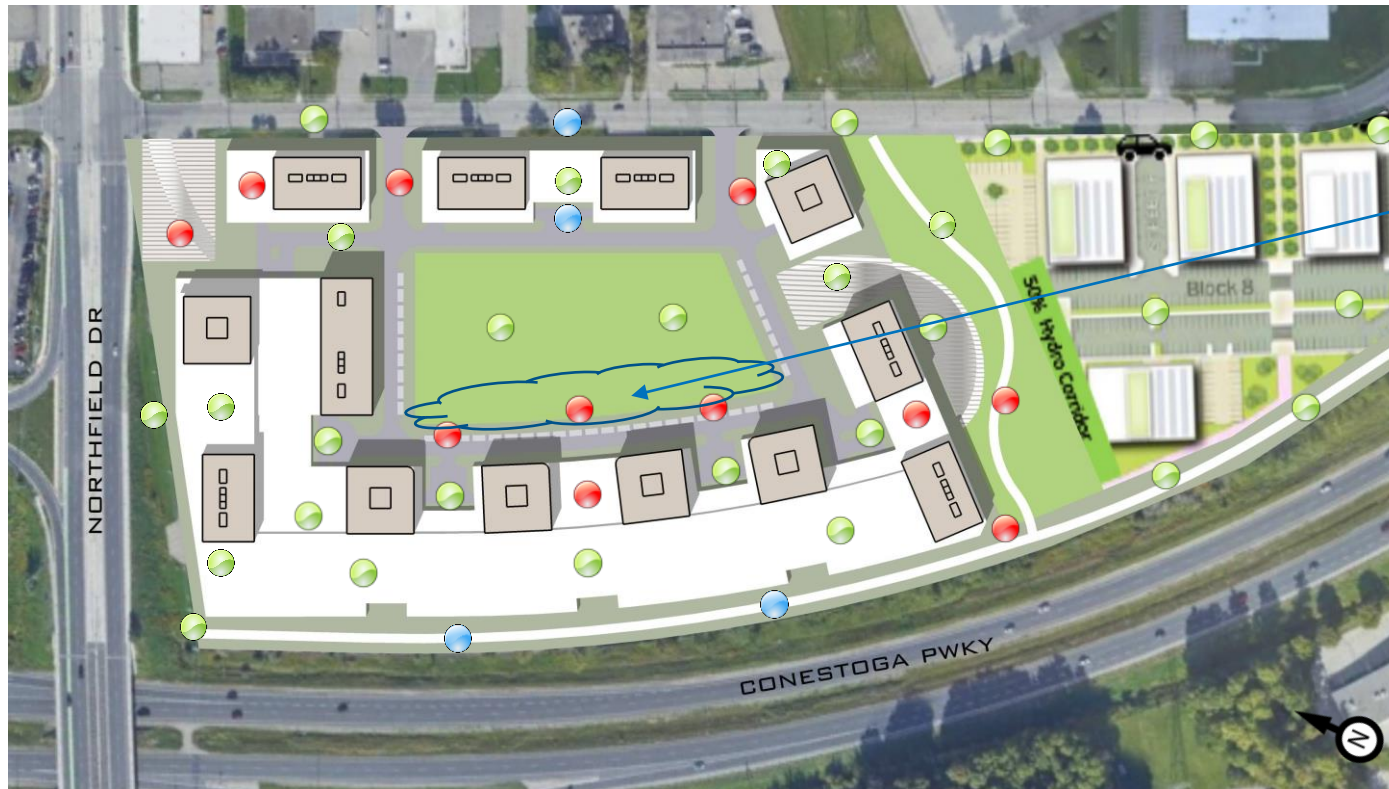


Image 7: Predicted *SUMMER* Wind Conditions

5. PEDESTRIAN WIND CONDITIONS



- Predicted *WINTER* Wind Conditions**
- Sitting / Standing
 - Strolling / Walking
 - Uncomfortable



Landscaping is planned in the park, particularly in this area, to mitigate wind conditions

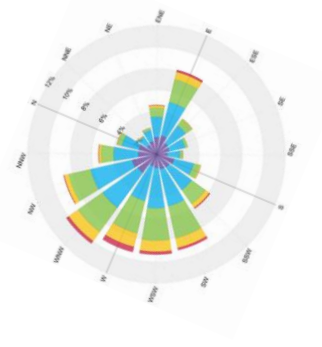


Image 8: Predicted *WINTER* Wind Conditions

6. EXAMPLES OF WIND CONTROL STRATEGIES



Image 9 – Examples of Wind Control Solutions at Grade: Building Massing Refinements, Canopies and Landscaping/Screens

6. EXAMPLES OF WIND CONTROL STRATEGIES



Image 10 – Examples of Wind Control Solutions at the Entrances and Outdoor Areas

7. SUMMARY



RWDI was retained to provide an assessment of the potential pedestrian level wind impact of the proposed development at 525-565 Conestogo Road in Waterloo, ON. Our assessment was based on the local wind climate, the current design of the proposed development, the existing surrounding buildings, our experience with wind tunnel testing of similar buildings, and screening-level modelling.

Our findings are summarized as follows:

- Wind speeds on and around the existing site are comfortable for the intended pedestrian use. At all areas around the site, wind speeds meet the pedestrian wind safety criterion.
- The proposed towers are significantly taller than buildings in the existing surroundings, and therefore will cause an increase in wind speeds around it. The proposed project benefits from several positive design aspects, including the large podiums, which will moderate the wind impact of the project. No negative wind impact is expected on the surrounding neighbourhoods.
- Wind speeds on the sidewalks/walkways/trails are expected to be suitable for active pedestrian use throughout the year, except for areas near the northeast and southwest corners of the block occupied by the towers and the gap between east towers where higher wind speeds are predicted in the winter.
- Mitigation concepts have been recommended at most entrance locations throughout the year, due to the exposure to turbulent wind

downdrafts and winds that accelerate between towers. Suitable wind conditions are expected at the entrance of the east towers.

- Appropriate wind conditions are predicted on the central park in the summer, with slightly higher wind speeds at the west end. Wind conditions on the podium roofs are generally expected to be higher-than-desired for passive use in the summer. In the winter, increased wind speeds and potentially uncomfortable conditions are expected on the park and podium roofs.
- Wind control solutions to reduce the wind speeds at the windy areas are discussed in the report

Scale model testing in a wind tunnel is recommended for this project to confirm and quantify the predictions in this report and refine wind control strategies where required. Interim wind conditions due to phasing of the construction should also be evaluated. RWDI is working with the design team to conduct such testing when the plans have evolved to an appropriate level.

8. STATEMENT OF LIMITATIONS



Design Assumptions

The findings/recommendations in this report are based on the building geometry and architectural drawings communicated to RWDI in January and February 2023, listed below. Should the details of the proposed design and/or geometry of the building change significantly, results may vary.

File Name	File Type	Date Received (mm/dd/yyyy)
65 Northfield Drive Development Concept	PDF	01/19/2023
13119P01 - Park Design -2023-01-10	PDF	01/19/2023
2023-02-17_3D Massing Model	DWG	02/17/2023

Changes to the Design or Environment

It should be noted that wind comfort is subjective and can be sensitive to changes in building design and operation that are possible during the life of a building. These could be, for example: outdoor programming, operation of doors, elevators, and shafts pressurizing the tower, changes in furniture layout, etc.. In the event of changes to the design, construction, or operation of the building in the future, RWDI could provide an assessment of their impact on the discussions included in this report. It is the responsibility of Others to contact RWDI to initiate this process.

Limitations

This report was prepared by Rowan Williams Davies & Irwin Inc. for GSP Group Inc. ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein and authorized scope. The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.