

# WAVERLEY WEST ARTERIAL ROADS PROJECT – PART III

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## PAPER ABSTRACT

The Waverley West Arterial Roads Project extends Kenaston Boulevard, a major arterial route in Winnipeg, to the Perimeter Highway, creating a new north-south economic route in southwest Winnipeg and servicing the new Waverley West neighbourhoods.

This complex, multi-disciplinary project had unique design aspects that were considered in the delivery of this project. The tri-level government funded project was split into three parts to be able to quickly get key pieces of infrastructure built first and to stage design and construction such that the schedule could be met. This paper will focus on Part III, which was the largest of the parts.

Unique features of Part III include splitting the Kenaston arterial into a one-way pair around the Bridgwater Town Centre, intended to be the focal point for the sub-development. Active transportation paths were constructed along the arterial and meld seamlessly into neighbourhood pathways, providing opportunities for bicycling commuting.

To optimize condensed final design time-frames and construction scheduling, the work items for this \$46 million project were divided and tendered under four contracts. Unique challenges on the construction side included messaging to the public the staged openings of new infrastructure, co-ordinating third party construction so that all schedules could be met, and constructing a bridge through one of Winnipeg's coldest winters on record.

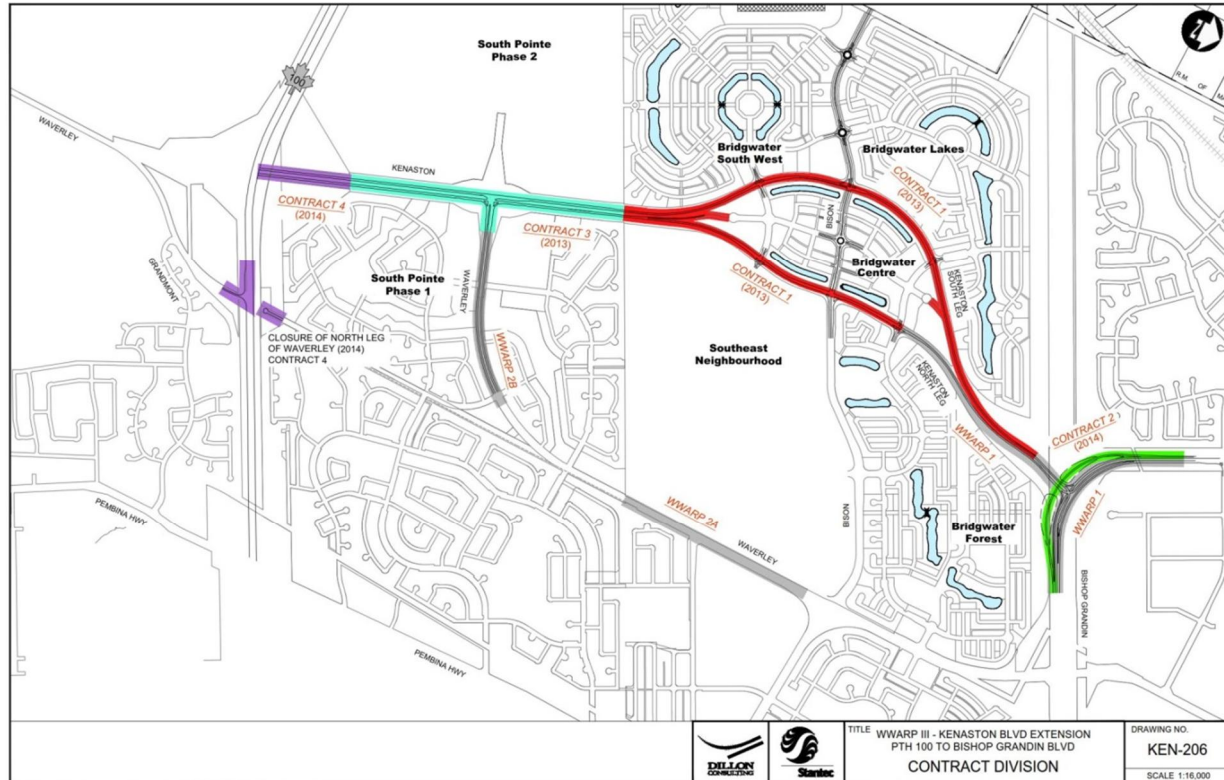
This paper highlights the transportation field's promotion of sustainable and economic viability through innovative infrastructure design and walkable and multi-use infrastructure integration into the Waverley West neighbourhood.

Dillon Consulting Limited with their sub-consultant Stantec Consulting Ltd. undertook the design and construction administration of WWARP Part III for the City of Winnipeg.

## 1 PROJECT BACKGROUND

Planning for development of the City of Winnipeg's southwest quadrant began in the early 2000's. The area is typically referred to as the "Waverley West" neighbourhoods. At full build out, it is anticipated that the area will be home to over 40,000 people.

To service an area of this size, and provide improved arterial connections with the greater region, the City of Winnipeg initiated the Waverley West Arterial Roads Project (WWARP). This paper focuses on Part III, which was the largest of the three parts. The following figure illustrates the project area, indicating the three parts of WWARP, and the four construction contracts within WWARP Part III itself.



**Figure 1: WWARP III Contract Division**

Kenaston Boulevard (Kenaston) was designated an economic route within the City of Winnipeg, Capital, Region and Province of Manitoba. Due to the linkage it provides between major industrial/commercial sites and national/ international trade routes, it handles a large volume of truck traffic that has resulted in significant cost savings for the transport industry. Kenaston also provides access to new residential and commercial zones within the Waverley West neighbourhoods and, as a result, provides service to high volumes of commuter traffic. Lastly, Kenaston functions to provide a corridor for inter-neighbourhood travel, commuter active transportation, and transit networks.

## 2 PROJECT SCOPE

The WWARP project as a whole is comprised of over 40 lane-kilometres of high speed roadway connecting Kenaston to P.T.H. 100, including a 105 m overpass structure. Design components included the following:

- Public Consultation and Community Connection
- Noise Assessment Study
- Traffic Operational Study
- Geometric Design of Roadways and the Overpass Structure
- Structural Design of the Overpass, including innovative use of Mechanically Stabilized Earth (MSE) walls
- Pavement Design and Life Cycle Cost Analysis

- Active Transportation Facilities
- Coordination of Utility Relocations
- Risk Management
- Value Engineering and Safety Audits

Geometric design is key to every new transportation infrastructure project, and each has its own challenges. The design team took into consideration the developer's vision of the community, which included a "Town Centre" intended to be the focal point for the neighbourhood, providing shopping, active living, multi-family, and family services, all within walking distance of home. Current standards were applied, designs refined, and innovative ideas used to design and construct a safe, high speed arterial to modern standards that just as importantly met community needs, resulting in splitting the Kenaston arterial into a one-way pair around the "Bridgwater Town Centre". Active transportation paths were constructed along the arterial and meld seamlessly into neighbourhood pathways, providing opportunities for both recreational and commuter cycling.

To optimize condensed final design time-frames and construction scheduling, the work items for this \$46 million project were divided and tendered under four contracts. Unique challenges on the construction side included a complex bridge design with mechanically stabilized earth (MSE) walls that held the project on City of Winnipeg lands. Messaging to the public of staged openings of the infrastructure, and co-coordinating third party construction was of utmost importance so that all schedules could be met, and the City of Winnipeg's obligations to government partners, developers, and the public could be maintained. The following sections demonstrate the project team's application of technology, the impact of the project on the greater neighbourhood and environment, the complexity of the project, and how the owner's needs were met.

## 2.1 Contract 1

The limits of Contract 1 were set based on a number of factors. Of prime importance was to get Kenaston constructed and open to traffic to service the Bridgwater Lakes and Bridgwater South West neighbourhoods as soon as possible. Prior to Part III being constructed, a two lane portion of Kenaston, including a new at-grade intersection from Bishop Grandin Boulevard (Bishop Grandin) to North Town Road was built as WWARP Part I. Contract 1 would provide a full four lane facility from Bishop Grandin south to South Town Road, and ultimately to the border between the Bridgwater and South Pointe neighbourhoods. For these reasons, Contract 1 was designated to be the first to construction.

A traffic operational study was undertaken for the entire WWARP III project area. However, the results of this study are most evident in the Contract 1 area. Analysis was used to determine storage lane lengths, which were optimized geometrically based on site conditions. Confirmation was made that a four lane facility plus auxiliary lanes as necessary was sufficient for the short term. Expansion to a six lane facility will be needed, and can be staged to follow neighbourhood growth. Geometrically, the roadway (and street lighting) was designed for easy expansion towards the "middle", so that intersection reconfiguration is minimized and cost optimized.



**Figure 2: Kenaston SB Lanes in Foreground, with Off-ramp to Roundabouts and Internal Roadways in the “Bridgwater Town Centre”**

Contract 1 had unique geometric design challenges. All design had to accommodate a future six lane facility, so intersection crossfalls had to be carefully designed to be “future proof”. The curvilinear alignment of Kenaston also presented challenges with back to back superelevation, noise berm height requirements, and intersection sight distance. For the latter, a study was undertaken to determine if there were any issues with sight distance at the six intersections (plus Waverley Street). Consideration had to be made to visibility if signals were in flash mode or out of commission. Alterations to berm locations and landscaping plantings were suggested to improve safety. The Bridgwater Centre, to which Contract 1 surrounds, is designed to be a dense, walkable community. Therefore, the character of Kenaston must change when in this area. An urban cross-section was selected to best mesh with the Centre. The roadway maintains a consistent, 90 km/hr design speed, but the right-of-way and thus corridor is more compact, sans shoulders or ditches, and is faster to cross for pedestrians and cyclists. Outside of Bridgwater Centre, the roadway was designed to transition to a more cost effective, open rural cross-section, where less interaction with other travel modes occur.

Another feature worth mentioning within the Contract 1 description, but that applies to all four contracts, is safety. This applies not only to drivers, but to active transportation users as well. The latest in roadside hazard avoidance and protection were implemented. Overhead sign structure poles were located out of the clear zone where possible. On lower order intersecting collector streets, the poles were protected with an architecturally pleasing “safety shape” curb,



which blends with the landscaping, yet provides the level of protection for drivers warranted. Breakaway signal poles and street light poles were utilized, and where necessary, guardrail with end-treatments were installed if roadside elements could not be relocated. Active transportation paths were moved away from the road edge, and in many cases elevated on the noise berms for further protection from errant vehicles. Universal design elements were incorporated to be inclusive of those with mobility, vision, or hearing impairments. This includes detectible tiles at intersection crossings, dissimilar materials at path edges to guide visually impaired and wide multi-use paths more than adequate for two wheelchairs abreast.

## 2.2 Contract 2

Kenaston Overpass is the first grade-separated structure, not involving a water or railway, constructed in Winnipeg in over 20 years. Built under Contract 2, the Kenaston Overpass consists of a two-lane bridge structure and ramp lanes that connect southbound Kenaston to eastbound Bishop Grandin. With the realignment of the through-lane over the bridge, modifications and improvements at the Kenaston and Bishop Grandin at-grade intersection were also completed.



**Figure 3: Completed Kenaston Overpass**

Residents in the long established adjacent Whyte Ridge neighbourhood, and even the new Bridgwater Forest neighbourhood backing onto Kenaston and Bishop Grandin respectively, were concerned about noise and light pollution from the project. A modeling analysis was undertaken to determine the impact of the new ramp and overpass geometry to see if noise mitigation measures (such as a sound wall) would be required. While no infrastructure was necessary, the project team took measures to mitigate noise and light regardless, as part of our responsibility of

bettering the public experience. For example, the concrete barrier on the south side of the overpass was carried down the embankment until almost at prairie grade. This provides some noise protection, but also limited light pollution from headlights into Bridgwater. This also had the side benefit of protection of the high voltage transmission tower from errant vehicles. Design features such as these were not required, but were seen as value added to the public and other third parties.

In October 2013, bridge construction commenced with the steel H-pile foundations. Maintaining right-of-way traffic throughout the piling operations was complex due to the size and working radius of the piling equipment. Even with the closure of both median lanes for northbound and southbound Kenaston, access was limited during piling operations in the median. Additionally, the excavation for the pier footing also brought the excavation footprint to within 1 m of the roadway, so an H-pile and timber lagging shoring system was required to support the trench walls during pile driving operations.

Five substructure units were constructed; a centre pier and two semi-integral abutments, each consisting of a grade beam and abutment bearing seat. The purpose of the semi-integral abutments was to move the expansion joint away from the abutment bearing seat to the grade beam in order to protect the ends of girders and the bearings from exposure to moisture and salts, effectively increasing the service life before major rehabilitation was required. Galvanized steel reinforcing was used for the substructure as another effort to increase the bridge's service life.

The substructure was constructed during Winnipeg's coldest winter in over 100 years. Thus, concrete curing was closely monitored to ensure the cold did not compromise the integrity of the structures. A hoarding and heating system was required for the abutments as the existing grade was 4 m below the underside of the abutment. The existing ground had to be excavated down for the permanent retaining walls, which meant that extensive scaffolding was required for the grade beam and bearing seat construction.

An unexpected challenge occurred during the placement of the substructure concrete. Boils appeared on the surface of the concrete during concrete placement. An investigation was initiated and included suppliers, material testers, and academia. Cores were taken from the structures and, after thorough material investigation and review, it was concluded the boils were a result of the concrete reacting with the zinc-rich paint used to touch up the galvanized reinforcing. The boils were drilled out and sealed to restore the integrity of the concrete at the boil locations.

Six pot bearings support the bridge superstructure. Uni-directional expansion bearings were installed at the abutments and fixed bearings at the pier. The bearings were supported with steel shims and braced with temporary bracing since the anchor rods were not grouted prior to girder erection to protect against potential variations in girder fabrication.

The roadway had a large horizontal curve to accommodate the turn from southbound Kenaston to eastbound Bishop Grandin. This caused eccentric loading and torsion in the superstructure system. Steel trapezoidal box girders were chosen for their torsional stability and long span

lengths. The span lengths were 45 m and 60 m and varied to account for the future extension of Bishop Grandin under the overpass.

The girders were fabricated from weathering steel, a low maintenance alternative to painted steel. A structural steel coating system was applied to the areas subject to high risk of deterioration; at the abutments. Complex geometry made girder fabrication a significant challenge. The steel trapezoidal box girders were designed with a 5.2% superelevation and distinct horizontal and vertical curve. Several details were not possible to depict in standard 2D detailing or drawings so, during the 3D CAD development process, potential conflict locations were identified and addressed in collaboration between the designers and detailers.

Two girder lines span from abutment to abutment, each girder line made of three sections. The sections are 35 m in length and 2.2 m and 2.0 m in height; heights varying to account for the superelevation. The complex geometry made fabrication difficult. Translating stock plate into highly controlled shapes required extensive layout and planning as well as the construction of specialized jigs to facilitate assembly of the various components. Once a girder section was assembled, the fabrication plant was only long enough for a single progressive assembly segment; which consists of butting adjacent girders end to end and drilling unique splice plates for that connection. The schedule was monitored rigorously to ensure there was no lost time waiting for progressive assembly, as there was limited room in the assembly space.

Girder erection was a challenging operation which required increased planning, scheduling, and supervisory efforts. Girders were erected during the cool, wet month of April and high winds delayed lifting the large sections into place. Despite poor weather conditions, complex traffic staging, and difficult geometry, the girders were safely and efficiently erected as a result of effective planning efforts. Progressive assembly mitigated difficulty installing the field splices; wind speed monitoring ensured safe lifting of sections; efficient switchovers minimized traffic flow disruptions and increased inspection and supervisory efforts ensured smooth, safe, and accurate operations. Although the girders spanned over 100 m, the accuracy during fabrication and erection efforts required only one of the bearings had to be adjusted following girder erection.

There was a short window between substructure construction and girder erection where deck formwork was prefabricated to facilitate timely deck construction. The result of the prefabrication was a deck that was completely formed in four weeks, a feat remarked by all members of the project team considering the complexity of forming. Four layers of joist forms were used for deck forming because the top layer disconnected at each of the girder's 56 lateral braces. Overhangs, end concrete diaphragms, fascia, drip strips, girder flange haunches, screed machine rails also contributed to the complexity of the forming process.

As the concrete deck and barriers see the majority of the physical and chemical attack due to sand and de-icing salts, it was critical to undertake durability based design. Significant clear cover, stainless steel reinforcing, and a waterproofing and asphaltic wearing surface were chosen to increase the service life of the structure. Concrete pours were scheduled during the evening and night, so initial setting occurred under cooler temperatures and reduced the susceptibility for differential thermal stresses typically associated with hot weather and sunshine. A well was

drilled onsite to facilitate a continuous wet cure system for the deck. The placement and curing regime was monitored closely and together they mitigated potential thermal and drying shrinkage during plastic and hardened states.



**Figure 5: Girder Erection**



**Figure 4: Concrete Deck Construction**

The limited right-of-way in the overpass area resulted in design challenges for the final road profile. Immediately to the south of the overpass is a Manitoba Hydro corridor, of which the ground elevation could not be altered. To the north are the existing lanes of Bishop Grandin. This resulted in a tight horizontal radius. With bridge barriers in place, the design team realized that stopping sight distance was not achievable. As an example of the ingenuity of the team, the geometry was reworked with a higher superelevation to further reduce the radii, and the inner road shoulder was widened to 3.5 m, effectively allowing drivers to see “across the curve”. This was key to working within the site limitations.

The approach embankments are supported by a vertically faced retaining wall. A retaining wall was required because the 5H:1V embankments would have extended well outside the available footprint and would have encroached on the surrounding roadways. For this project a mechanically stabilized earth (MSE) wall was chosen for its aesthetic appeal and modular construction. MSE walls are relatively new to Manitoba and the Kenaston Overpass is one of the largest applications in Manitoba to date. The MSE wall are single-stage retaining walls made of precast concrete panels, forming the face of the walls, and galvanized steel soil reinforcing strips anchoring the panels into and reinforcing the backfill. An aesthetic treatment, inspired by the Aurora Borealis, was imprinted on the faces of the embankment walls. Durability is paramount for MSE wall design and construction as rehabilitation and replacement of individual areas is extremely complex and therefore major rehabilitation programs are not possible throughout the service life of the system. Assembly and backfilling operations and materials were highly monitored and controlled to maintain the MSE wall’s 100 year service life.

Modular MSE wall systems are highly susceptible to differential movement caused by expansion and settlement. At its highest point, the MSE wall is almost 9 m tall and long term settlement on the underlying clay was substrata was a major concern. To provide uniform settlement, the backfill consisted of lightweight concrete and compacted granular material in varying



thicknesses to equalize the foundation pressure. The lightweight concrete backfill is lighter than water, due to its high air content, but with performance characteristics comparable to that of the surrounding clay. The approach embankments were constructed earlier in the WWARP III project and partially acted as preloading for early high settlement periods. The embankments also were stepped together with the backfill to accommodate uniform foundation loading.



**Figure 6: MSE Wall Construction with “Aurora Borealis” Aesthetic Surface Treatment**

Several fibre optic communication cables and a high pressure gas line crossed the area where the MSE walls were to be constructed. During the design process the location of the utilities were thoroughly investigated and the MSE wall panel elevations were adjusted to avoid conflicts. Extreme care was exercised to mark and avoid these lines during excavation.

During excavation of the lowest MSE wall section around the abutments, a layer of silt material was discovered. Due to the highly expansive nature of silt and potential for differential settlement, the silt material was deemed not appropriate for base under the MSE wall and operations were halted until the silt seam was excavated and replaced with compacted limestone. While the silt seam extended throughout the site, only the exposed portions near the abutments were of concern as the other sections of the MSE walls had a thick layer of clay protecting against water migration.

Over 900 panels were transported to site from British Columbia and were organized in multiple laydown areas to accommodate the current progression of erection. Bracing panels for stability during construction was a challenge and required constant monitoring during panel placement and backfill operations. For the lower panels, they were braced outwards. As the height of the wall increased the panels had to be braced to adjacent panels, as they are vertically stepped.

Vibrations resulting from backfill compaction operations caused deflection of the panels so the magnitude of deflection had to be predicted and panels were set out-of-plumb inwards to counteract deflections.

Lightweight concrete was pumped from the plant, located in the west laydown area, through a hose to the embankment being backfilled. The hose could not run across the active roadway, so deck overhang construction was expedited and the hose was run up and over the bridge to reach the east embankment. Special hose sections and connections were required for the bends in order to maintain proper pumping. The system was successfully used and monitored daily with no issues.



**Figure 7: Pumping of Lightweight Concrete Fill**

Completed on time and on budget, Contract 2 benefitted from a strong and positive relationship between the engineering team, contractor, subcontractors, client, and external stakeholders. In addition to bi-weekly site meetings chaired by the contract administrator, weekly coordination meetings were held during periods of complex staging, such as during girder erection, major road closures, and overpass switchover to traffic. These meetings smoothed out the coordination of the activities taking place onsite and facilitated successful completion of the Kenaston Overpass in October 2014.

### **2.3 Contract 3**

While Contract 3 was the most straightforward section constructed, with approximately 2 km in length of four lane rural roadway, it is useful to highlight a few features here that were used throughout the project. As with any infrastructure project, cost is of utmost concern, so optimizing the design and applying cost effective treatments are very beneficial. Many City of Winnipeg streets, which are usually urban in nature with curbs, also contain sub-drains running parallel with the roadway under the sub-grade. This maintains a low moisture level in the road

structure, preventing freeze-thaw related frost boils, or soft sub-grade and early degradation of the road. Since there was a rural cross-section in Contract 3, it was decided that the sub-drains could be eliminated and the road structure would drain to the adjacent ditches by the use of a 1 m wide “french drain” every 50 m. Clean stone wrapped in geotextile was used to convey moisture through the embankment. This was a simple, yet effective improvement that should extend the life of the pavement.

Another feature used notably at the Waverley Street (Waverley) intersection is a “smart channel”. Typically, right turn channels, or right turn cut-offs are seen at major intersections. They allow right turning traffic to avoid the signalized intersection and make a yield movement. They also provide pedestrian refuge and a reduced crossing distance. Smart channels are an improvement in that the angle for the yielding driver allows them to “look left” with less strain, but slows them further than a typical channel due to the acute geometry. This is safer for pedestrians and prepares the driver to exit the high speed facility (Kenaston) and enter the lower speed facility (Waverley). Figure 8 shows the smart channels in the bottom right and top left corners going from the major to minor roadway.



**Figure 8: Smart Channels going from Major to Minor Roadway**

## **2.4 Contract 4**

Contract 4, which involved the final 500 m in length of Kenaston, the connection of Kenaston to P.T.H. 100, and the disconnection of the north leg of Waverley from P.T.H. 100, was the final contract to construction. This was to allow time for property acquisition and the added complexity of design reviews and approval from both the City of Winnipeg and Province of Manitoba as the Perimeter Highway is under Manitoba Infrastructure and Transportation (MIT) jurisdiction.



Construction staging was complex for this contract. While the Kenaston extension was not open to the public, the south Perimeter Highway carries thousands of vehicles a day, and was also seeing construction in the adjacent Pembina Highway interchange. Co-ordination was required by the contract administration team to mesh traffic control in the work areas, minimize lane closures, and maintain a safe working and driving environment.

Through the risk analysis for the project, the construction of the traffic signal infrastructure by MIT, and street lighting by Manitoba Hydro was flagged as an area where co-ordination and timing would be an issue. To mitigate, the contract administration and construction of both was added to the scope of services provided by the design engineers. This allowed for one prime contractor to schedule and be responsible for the work, ensuring the intersection would be ready for traffic once the road was built.

## **2.5 Active Transportation**

Accommodation of active transportation (pedestrians, cyclists, etc.) was a project factor for all four contracts. With the Bridgwater Centre, Contract 1 offered the most opportunity to build and connect a network of pathways and sidewalks to service the neighbourhoods. Careful consideration was made when designing the active transportation paths in this area. Meetings and designs were exchanged with the developers to create a seamless network. Pathways running parallel to the northbound and southbound one way pairs of Kenaston are the backbone of the network, with connections into the neighbourhoods not only at the cross-streets of North Town, Bison, and South Town, but at mid-block points as well. The network creates a viable means of commuting by cycling into Winnipeg.

The Kenaston right-of-way was designed not only to accommodate future widening of Kenaston, but also of the active transportation network as well. South of the Bridgwater Centre, the multi-use path is constructed only on the west side. However, the boulevard and noise berms were designed with a “shelf” for a future pathway on the east side as well. In this way, as the neighbourhoods develop, so can the network of active transportation paths. Reserved space exists for the pathways to one day be extended to the south Perimeter, to potentially connect via a future interchange into the St. Norbert neighbourhood and beyond.





**Figure 9: Active Transportation Paths Constructed along SB Kenaston**

The intersection of Kenaston and Bishop Grandin with the overpass is a unique one, and it presented a challenge to include the multi-use paths. Pedestrian desire lines are satisfied in the ample radii and multiple alignments, and the open concept of the underpass is used to its advantage to provide good sightlines to the vehicle intersection. This project has the distinction of completing the over 11 km long Bishop Grandin Greenway, allowing active users to travel from southeast to southwest Winnipeg on their own separated facility. CPTED principles (Crime Prevention Through Environmental Design) were used during design. For example, the pathway was kept closer to the roadway for improved lighting and visibility.

### **3 PROJECT CO-ORDINATION AND STAGING**

One of the major achievements of WWARP III is not any one technical achievement, but in putting all the pieces of the project together in the right order, such that it could be opened safely and on time. The project represents over 40 lane-kilometres of new roadway. Putting this much pavement into use at once is unprecedented in the City of Winnipeg. There were numerous pressures on the consulting team and the City of Winnipeg while staging this project.

At the onset of the project, the project size was evaluated with consideration given to the volume of materials, manpower, and seasonal ability to construct. The limits and scope of the four contracts were determined via this analysis. Contracts 1 and 3 were initiated first with construction complete in 2013. This ensured a milestone of servicing the Bridgwater neighbourhoods was met. These two contracts were able to be large in physical size and materials as the projects were greenfield and did not require complex traffic staging. Contract 2 was centred around the overpass structure, the complexity of which required the longest time of all four contracts. Girder fabrication timeframes were key, and work that could be accomplished during the winter months like piling and sub-structure construction were factored into the schedule. This contract began in the fall of 2013 with substantial completion achieved one year later in October 2014. Contract 4 was purposely rolled out last to permit time for property acquisition and approvals from MIT due to the connection to the Perimeter. The order and division of the contracts was key to meeting the project schedule.

Each contract had its own construction and traffic staging challenges. However, it was the overall Kenaston opening that is one of the impressive features of this project. The consulting team was aware that public communication was key to informing residents and allaying concerns about the project. Information on what was being built and why or why not it was opened was communicated through newsletter mailers, the City of Winnipeg's project website, and media releases. Care was taken to package information using graphics and maps as necessary to convey a clear message. The media releases were vital at later stages when sections of Kenaston were opened, as a new facility can be confusing for first time users.

Staging co-ordination involved multiple parties. Not only did contract administrator perform co-ordination of the WWARP III contracts, but also facilitated co-ordination with major stakeholders. Stakeholders included:

***Developers*** – Developers were building intersecting collector streets and active transportation paths. Home builders were utilizing Kenaston both before and after it was opened to the public to access their jobsites. Construction of noise attenuation berms and noise walls were accessed from Kenaston. It was important to ensure developer roadways were clean, passable, and had full traffic control present before either they or Kenaston could be opened. Another example of the symbiotic relationship of the developments and Kenaston is the drainage in the Contract 1 area. The retention ponds built by the developer are used to drain Kenaston. Construction of the roadway began prior to some of the ponds being dug, so pipe storage and temporary overland drains were used in the interim. This had to be factored into roadway opening.

***Manitoba Hydro*** – Providing power supply for the developers, traffic signals, and installing and powering street lights.

***City of Winnipeg Services*** – Traffic signal design and installation, and all regulatory line painting and signs such as speed limits, parking restrictions, stop and yield signs are all required to be in place before opening. Strong co-ordination was also required between the Traffic Services branch and the contract administrator to co-ordinate temporary traffic control in the complex areas such as Contract 2.

**WWARP III Contracts** – Direct instruction and co-ordination by the consulting team with contractors. This work began in the design phase with detailed staging plans meant to maintain traffic with minimal disruption. During construction, this involved daily and longer term temporary lane closures, temporary roadway construction, and weekend shutdowns intended to minimize inconvenience.

Starting in July of 2014, the consulting team organized and led meetings between all stakeholders together in one room. This was found to be most beneficial in determining not only stakeholder needs, but the critical path for the staging work. As an example of the value of these meetings, the consultant team knew that the overpass structure would not be ready for its scheduled opening day in August of 2014. This date was critical to allow enough time to reconstruct the Kenaston/Bishop at grade intersection and associated lanes before the winter of 2014. The team proposed shortening the intersection works timeframe via rerouting of traffic down the new Waverley extension, thereby eliminating some temporary pavement works. Decisions in the meeting allowed for immediate media releases of traffic changes and got the overall schedule back on track.

#### **4 PROJECT SUMMARY**

Due to the linkage it provides between major industrial/commercial sites and national/international trade routes, the Kenaston extension handles a large volume of truck traffic, which has resulted in significant cost savings for the transport industry. Furthermore, WWARP III highlights the transportation field’s promotion of sustainable and economic viability through innovative infrastructure design and walkable and multi-use infrastructure integration into the Waverley West neighbourhood. The project provides real world examples of challenges faced when translating standards and guidelines on paper, onto pavement in the field. The safety of road users was of utmost importance and good geometric design was key to building a facility that protects users, yet at the same time allows for efficient movement.



**Figure 10: Kenaston at Waverley**

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