



REGIONAL DISTRICT OF CENTRAL OKANAGAN
GOVERNANCE AND SERVICES COMMITTEE MEETING
AGENDA

Thursday, November 14, 2019

8:40 a.m.

Woodhaven Board Room
1450 K.L.O. Road, Kelowna, BC

Pages

1. CALL TO ORDER

Chair Given acknowledged that this meeting is being held on the traditional territory of the syilx/Okanagan peoples.

2. ADDITION OF LATE ITEMS

3. ADOPTION OF THE AGENDA

Recommended Motion:

THAT the agenda be adopted.

4. ADOPTION OF MINUTES

4.1 Governance and Services Committee Meeting Minutes - October 10, 2019

1 - 7

Recommended Motion:

THAT the Governance and Services Committee meeting minutes of October 10, 2019 be adopted.

5. DELEGATIONS

5.1 STPCO and Regional Plan Update - Stephen Power, Lead Consultant Regional Transportation Plan

8 - 39

Jerry Dombowsky, Transit and Programs Manager and Mariah VanZerr, Transportation Planning Manager - City of Kelowna

Recommended Motion:

THAT the STPCO and Regional Plan Update presented by Stephen Power, Lead Consultant-Regional Transportation Plan be received for information.

6. CORPORATE SERVICES

6.1 Q3 Video Highlights of Regional District Services

Recommended Motion:

THAT the Q3 video highlights of Regional District services be received for information.

7. REGIONAL PARKS SERVICES

7.1 Proposed Johns Family Nature Conservancy Dark Sky Preserve Report

40 - 114

Recommended Motion:

THAT the Governance and Services Committee recommends the Regional Board support RDCO staff submitting an application through the Royal Astronomical Society of Canada for the nomination of Johns Family Nature Conservancy Regional Park as a Dark Sky Preserve;

AND FURTHER THAT the Governance and Services Committee recommends that the Regional Board approve the establishment of a Dark-Sky Preserve at Johns Family Nature Conservancy Regional Park with the receipt of confirmation of a successful application from the RASC.

8. ADJOURN

Minutes of the **GOVERNANCE & SERVICES COMMITTEE** meeting of the Regional District of Central Okanagan held at Regional District Offices, 1450 KLO Road, Kelowna, BC on Thursday, October 10, 2019

Directors: J. Baker (District of Lake Country)
M. Bartyik (Central Okanagan East Electoral Area)
C. Basran (City of Kelowna)
W. Carson (Central Okanagan West Electoral Area)
M. DeHart (City of Kelowna)
C. Fortin (District of Peachland)
G. Given (City of Kelowna)
C. Hodge (City of Kelowna)
S. Johnston (City of West Kelowna)
D. Findlater, alternate for G. Milsom (City of West Kelowna)
B. Sieben (City of Kelowna)

Absent: L. Stack (City of Kelowna)
L. Wooldridge (City of Kelowna)
Representative for Westbank First Nation

Staff: B. Reardon, Chief Administrative Officer
T. Cashin, Director of Community Services
W. Darlington, Manager, Park Planning & Capital Projects
J. Foster, Director of Communication & Information Services
C. Griffiths, Director of Economic Development & Bylaw Services
D. Komaïke, Director of Engineering Services
M. Rilkoff, Director of Financial Services
S. Slaman, Business Development Coordinator
D. Dudzik, Environmental Planner
R. Kotscherofski, Manager of Fire Services
C. Coates, Waste Reduction Facilitator
I. Hodson, Supervisor-Community Relations & Visitor Services
S. Horning, Supervisor-Corporate Services (recording secretary)

1. CALL TO ORDER

Chair Given called the meeting to order at 8:35 a.m.

This meeting is being held on the traditional territory of the syilx/Okanagan peoples.

2. ADDITION OF LATE ITEMS

There are no late items for the agenda

3. ADOPTION OF THE AGENDA

#GS45/19

DEHART/FORTIN

THAT the agenda be adopted.

CARRIED unanimously

4. **ADOPTION OF MINUTES**

4.1 Governance & Services Committee Meeting Minutes – July 18, 2019

#GS46/19

HODGE/FORTIN

THAT the Governance & Services Committee meeting minutes of July 18, 2019 be adopted.

CARRIED unanimously

5. **DELEGATIONS**

5.1 2020-2025 Economic Development Commission Strategy

Staff thanked the members of the Advisory Council Executive for their input and introduced the members in attendance.

Staff report dated October 10, 2019 provided the Committee with an overview of the *Moving Forward to 2025* Economic Development Commission 2020-2025 Strategy.

The *Moving Forward to 2025* economic development commission strategy provides the strategy and focus area for the Regional District's Economic Development Commission to support growth and sustainability in the economy. The strategy includes an assessment of the region's value proposition through background research and economic analysis, community consultation and stakeholder engagement.

Director Basran arrived at 8:39

Jordon Tidey, Consultant, MDB Insight presented an overview of the strategy highlighting:

- The approach and methodology;
- The documents reviewed during the process:
 - RDCO Regional Growth Strategy: Priority Projects Plan 2017;
 - Growing in the Okanagan, 2020 Labour Market Outlook;
 - Economic Opportunities to 2020 Strategy for the Central Okanagan Region;
 - 2018 Central Okanagan Economic Profile and 5 Sector Profiles.
- The engagement activities:
 - Round Tables
 - One on One Interviews
 - Business Survey
 - Stakeholder Engagement Workshops

Questions from the Board followed.

Staff presented an overview of the implementation strategy and highlighted the innovative action categories. *Moving Forward to 2025* provides the foundation of what will be outlined in the publically available Operational Plan every year.

Each action detailed in the annual Operational Plan includes well defined objectives, rationale, tactics and measurements, all of which are monitored and reported on a quarterly basis. Questions from the Board followed.

#GS47/19

BARTYK/HODGE

THAT the Governance and Services Committee receives, for information, the presentation regarding the 2020-2025 Economic Development Commission Strategy;

AND THAT the Governance and Services Committee recommends the Regional Board endorses the *Moving Forward to 2025*, Economic Development Strategy.

CARRIED unanimously

5.2 BC Ambulance Service

Staff introduced the item and the presenter, Neil Lilley, Senior Provincial Executive Director, Patient Care, Communications and Planning, BC Emergency Health Services.

Neil Lilley, Senior Provincial Executive Director, BC Emergency Health Services, presented an overview of the (new) Clinical Response Model highlighting:

- The objectives of the model:
 - Improve response time to highest acuity;
 - Improve patient experience for medium acuity.
- The Clinical Response Model replaces the Resource Allocation Plan;
- Changes include:
 - Creating more categorization of calls to ensure the highest acuity so patients are responded to quicker;
 - Improving the resource allocation to 911 and transfer events;
- There is no change to the scope of practice for Paramedics;
- There is no change to the MPDS call assessment
- Objectives include:
 - Building the foundation for future changes to low acuity responses;
 - Reducing response times for high acuity (time sensitive) patients;
 - Better care for low acuity patients;
 - Aligning requests for First Responders and Fire Agencies to provide patients with the most appropriate care;
 - Addressing Fire and Municipal requests to ensure timely and effective use of FR resources
- The changes allow for:
 - Less time on the scene for First Responders;
 - Fewer calls First Responders need to attend and wait for an ambulance to be freed up;
 - More effective use of resources;
 - Improved patients/residents experience and outcomes;
 - Reduction in call volume is focused on the events where BCEHS responds routinely.

- BCEHS will request First Responders for all calls that meet certain criteria.
- BCEHS has changed the way in which it dispatches all resources and not just First Responder responses. This is to ensure that resources are more readily available for those events where time is critical.
- Noted that the BCEHS is establishing a rural fire working group committee to understand and address rural fire department issues.

Director Johnson returned at 10:26 a.m.

Questions from the Board followed.

#GS49/19

CARSON/BARTYIK

THAT the Governance and Services Committee receives, for information, the presentation by BC Emergency Health Services.

CARRIED unanimously

6. COMMUNITY SERVICES

6.1 Regional Growth Strategy Monitoring Program Update

Staff report dated October 10, 2019 updated the Committee on the Regional Growth Strategy Monitoring Program.

An RGS Monitoring Program was identified as a key element in the Priority Projects Plan to establish a program to monitor the implementation and progress being made towards achieving the RGS objectives.

Staff presented an overview of the monitoring program. The monitoring program has two components: (1) a framework for monitoring impact on RSG goals; and (2) A process for tracking implementation.

Paul Siggers, Project Coordinator, EcoPlan International, presented an overview of the project, consultation findings, monitoring program and project challenges and recommendations.

Director Johnson left at 10:01 a.m.

Questions from the Board followed.

#GS48/19

BAKER/SIEBEN

THAT the presentation on the Regional Growth Strategy Monitoring Program be received for information;

AND THAT the Governance and Services Committee recommends that the Regional Board endorse the Regional Growth Strategy Monitoring Program.

CARRIED unanimously

Meeting recessed at 10:11 a.m. Reconvened at 10:19 a.m.

BC Ambulance presentation occurred at this time.

6.2 Agricultural Compliance and Enforcement Strategy Update

Staff report dated October 10, 2019 updated the Committee on the Agricultural Compliance and Enforcement Strategy.

The Regional Agricultural Compliance and Enforcement Strategy will outline the Regional's

Staff provided an overview of the Agricultural Compliance and Enforcement Strategy.

#GS50/19

HODGE/BARTYIK

THAT the Governance and Services Committee receive the presentation from the Director of Community Services, dated October 10, 2019 regarding the Regional Agricultural Compliance and Enforcement Strategy for information.

CARRIED unanimously

7. ENGINEERING SERVICES

7.1 Curbside Update October 2019

Staff report dated October 3, 2019 updated the Committee on the 2019 curbside waste collection contract.

Staff presented the update and responded to questions from the Board.

#GS51/19

SIEBEN/DEHART

THAT the Governance and Services Committee receives for information the report from the Director of Communication & Information Services dated October 3, 2019 regarding the 2019 curbside waste collection contract.

CARRIED unanimously

7.2 Industrial Commercial and Institutional Recycling

Staff report dated October 2, 2019 informed the Committee regarding the Letter to Minister Heyman requesting the ICI Sector be included in BC's Recycling Regulation.

#GS52/19

BAKER/SIEBEN

THAT the Governance and Services Committee receives for information the report from the Director of Communication & Information Services dated October 2, 2019

regarding the Letter to Minister Heyman requesting the ICI Sector be included in BC's Recycling Regulation.

CARRIED unanimously

7.3 Clean Plastics Action Plan

Staff report dated October 2, 2019 informed the Committee on the submission to the Province in respect of the Clean BC Plastics Action Plan consultation.

Staff presented an overview of the submission and responded to questions from the Board.

#GS53/19

CARSON/DEHART

THAT the Governance and Services Committee receives for information the formal feedback submission to the Province as part of the Clean BC Plastics Action Plan consultation.

CARRIED unanimously

7.4 Development Cost Charge Review Update

Staff report dated October 1, 2019 updated the Committee on the Development Cost Charge review.

Staff provided an overview of the Development Cost Charge review and responded to questions from the Board.

Director Sieben left the meeting at 11:39 a.m.

#GS54/19

FORTIN/FINDLATER

THAT the Governance and Services Committee receives for information the Development Cost Charge Bylaw update.

CARRIED unanimously

8. PARK SERVICES

Director Johnson left the meeting at 11:52 a.m.

8.1 Regional Parks Visitor Services and Park Visit Update

Staff report dated October 3, 2019 updated the Committee on the 2018-2019 Regional Parks Visitor Services and Park Visits.

Staff provided an overview of the regional parks visitor services and park visits and responded to questions from the Board.

#GS55/19

HODGE/DEHART

THAT the Governance and Services Committee receives for information the 2018-2019 Regional Parks Visitor Services and Parks Visits update.

CARRIED unanimously

9. NEW BUSINESS

There was no new business.

10. ADJOURN

There being no further business the meeting was adjourned at 12:08 p.m.

CERTIFIED TO BE TRUE AND CORRECT

G. Given (Chair)

B. Reardon (Chief Administrative Officer)

Fall
2019

STPCO UPDATE

Quarterly Newsletter #5

This newsletter provides a brief update on the Sustainable Transportation Partnership of the Central Okanagan (STPCO) activities that occurred during summer and fall 2019.

The Sustainable Transportation Partnership of the Central Okanagan (STPCO) is a formal partnership of the City of Kelowna, City of West Kelowna, Districts of Lake Country and Peachland, Westbank First Nation and the Regional District of Central Okanagan. The organization coordinates the regional delivery of sustainable transportation programs and projects in support of common regional policy, plans and interests (economic, social and environmental).

STPCO Local Government Advisory Board:

- Colin Basran, Mayor, City of Kelowna
- Gord Milsom, Mayor, City of West Kelowna
- Gail Given, Chair, Regional District of Central Okanagan
- James Baker, Mayor, District of Lake Country
- Cindy Fortin, Mayor, District of Peachland
- Chief Christopher Derickson, Westbank First Nation



The STPCO also provides a formal forum for discussion amongst elected officials, senior and technical staff, as well as stakeholders and the general public. The next board meeting will be a facilitated workshop on November 13, 2019 to discuss the future of regional governance. For more information, contact Rafael Villarreal, rvillarreal@kelowna.ca or visit smartrips.ca/stpco-meetings.

City of Kelowna
City of West Kelowna
District of Lake Country
District of Peachland
Westbank First Nation
Regional District of Central Okanagan





Regional Bicycling and Trails Master Plan update underway

The Regional Bicycling and Trails Master Plan will provide an update to the Regional Active Transportation Master Plan that was adopted in 2012.

The 2012 plan presented a future bicycle and pedestrian network to provide safe and convenient travel options, connecting significant destinations across the region. It included design guidelines for a range of active transportation facility types to ensure a safe and comfortable experience for people walking and cycling.

In the years since the plan was created, many active transportation connections have been completed and additional active transportation plans have been developed by jurisdictions within the region.

Additionally, the province has recently released an Active Transportation Strategy. Updating the 2012 plan to align with recent changes will help focus the vision for bicycle and trail connections throughout the Central Okanagan.

The plan was kicked off in Fall 2019 and is being coordinated with development of the Regional Transportation Plan. Interviews are being scheduled with staff in each jurisdiction throughout October and November to gain an understanding of updates that have been made to the network since 2012. The plan is anticipated for completion in 2020.

To access the 2012 Master Plan, visit the Plans and Programs page at smartrtrips.ca/about/stpc0.

Regional Transportation Plan

In spring 2019, the regional transportation planning team launched Let's Talk Transportation – a public engagement event and questionnaire designed to understand the values of Central Okanagan residents and obtain input on potential transportation options. Since then, the project team has been busy analyzing the results of the engagement and conducting a corridor-level analysis to refine and screen the options. This fall the regional councils will hear an update on the refined options and plan status. In addition, a workshop on governance is planned for the Local Government Advisory Board in November. Completion of the plan is anticipated for 2020.



E-scooters gain more ground

Currently, any device which does not fit the Motor Vehicle Act's definition of a bicycle, wheelchair or motor vehicle is not permitted on public roads or sidewalks. This limits electric scooters to off-street pathways like the Okanagan Rail Trail. Uptake for e-scooters has been strong in Kelowna despite these limitations, with daily ridership more than three times greater than the Kelowna's pedal bikeshare pilot. The Province has recently introduced legislation to allow new vehicle types to be piloted on public roads with consent from local governments, which would increase opportunities to expand electric scooters and new mobility options in the region.

Help shape BTWW 2020

In 2019, more than 2,300 Central Okanagan residents registered for Bike to Work Week and collectively travelled 91,500 kilometres by bike, saving nearly 20,000 kilograms of greenhouse gases.

As we begin planning for Bike to Work Week 2020, we are looking for input on what motivates you to participate, what you like about the event and what can make this event even better.

Please complete the short questionnaire and share why you love BTWW by October 21, 2019 at getinvolved.kelowna.ca.



Transportation Updates



Fall transit service updates

Fall is a time of change in the Kelowna Regional Transit System with new routes and route names in effect as of September 1, 2019. Service levels on routes going to and from secondary and post-secondary schools were reinstated for the fall to reflect increased demand for transit at this time of year.

Three new routes and associated new bus stops were introduced on the Westside:

- Route 24 Shannon Ridge: replaces a portion of the existing route 24 Shannon Lake while also providing new service to the neighbourhoods along Shannon Ridge Dr. and Auburn Rd.
- Route 26 Old Okanagan: replaces the portion of the existing route 24 Shannon Lake serving along the Old Okanagan Hwy.
- Route 28 Shannon Lake: replaces the existing route 28 Smith Creek, maintaining service to Smith Creek while extending service to Tallus Ridge, Shannon Woods, and Crystal Springs neighbourhoods along Shannon Lake Rd.

Other adjustments included improved Sunday service and weekday evening service for route 97 Okanagan on the Westside, improved midday service on weekdays and Sunday service for the route 8 University/OK College, and weekday peak hour trips extended to serve the Ellison area on route 23 Lake Country. For a full list of seasonal service changes and updated route and schedule information, visit bctransit.com.

Fall Go by Bike Weeks

The province-wide Fall GoByBike Weeks event runs from October 21 - November 3, 2019.

This event encourages residents to ride their bikes to and from school, work and anywhere they need to go, as a form of everyday transportation.

This event also focuses on sharing safety and gear tips for the riding your bike in the fall season and weather.

Participants can register for free and earn a chance to win a cycling trip for two to the Baltics at GoByBikeBC.ca.



Connecting Our Region

Our first region-wide transportation plan



Let's Talk Transportation! Engagement Summary

July 2019



Introduction

Transportation across the region provides a vital connection to jobs, health care, education, recreation, shopping, emergency services, family and friends.

By 2040 the population in the Central Okanagan is expected to increase by 38% — almost 77,000 new residents. Future population growth provides both a challenge and an opportunity for us to find ways to move around the region that are better for people, the economy and the environment.

The issues facing all our communities — economic competitiveness, air quality, climate change, public health, quality of life — are directly impacted by the transportation choices we make today.

The Regional Transportation Plan is a long-range plan that will help shape the future of the Central Okanagan by identifying the transportation projects, programs and policies that will be needed over the next 20 years.

Working collaboratively across the region

The project is led by the Sustainable Transportation Partnership of the Central Okanagan (STPCO) — a collaboration of City of Kelowna, City of West Kelowna, District of Lake Country, District of Peachland, Westbank First Nation and Regional District of Central Okanagan.

Regional Transportation Plan Vision:

“A transportation system that connects people to regional destinations within the Central Okanagan and beyond, supporting and enhancing the region’s economy, social networks, and natural ecosystem.”

Engaging with people across the region

To understand the values and interests of Central Okanagan residents, the Regional Transportation Planning Team has been seeking input from the public and key stakeholders since 2018.

In the spring of 2019, the project team launched Let's Talk Transportation — a regional conversation that took place at the University of British Columbia Okanagan and an online questionnaire. This engagement summary provides the highlights of what we heard during this phase of engagement.

This information will be used to help shape the Central Okanagan's first regional transportation plan.



Let's Talk Transportation: The Conversation



How can we make transportation work for people, the economy and the environment?

On April 24, 2019, 90 people from across the region gathered at the University of British Columbia Okanagan (UBCO) to take part in an in-depth conversation about the future of transportation in the region.

Working in small groups, participants discussed ways to make getting around the region more accessible, more convenient and more enjoyable. They explored regional and community-specific transportation challenges and answered the question: "What do you dream about for the future of transportation?" They also took part in a series of small group discussions where they commented on potential transportation solutions for seven geographic areas of the region and added their own ideas about projects, programs and policies that would make travel through the region more accessible, convenient and enjoyable.

Let's Talk Transportation: The Questionnaire



To broaden the engagement, the project team sought input from the general public through a multipart, in-depth questionnaire posted to the smartTRIPS website. In total, 577 people shared their thoughts and opinions.

Questionnaire respondents were asked to comment on the same potential transportation solutions for seven geographic areas of the region and to indicate their level of support for 31 potential transportation solutions that were clustered into the following five categories:



Transit



Active transportation



Vehicle efficiency



Land use and development



Trip reduction and elimination

Outreach and promotion

The public was invited to participate in both the conversation and the questionnaire. Invitations and notices were circulated through social media networks, the smartTRIPS website, posters and news releases.

Special effort was made to reach all communities in the project's geographic area including Peachland, West Kelowna, Westbank First Nation, Kelowna, Lake Country and the Central Okanagan East and West Electoral Areas. Effort was also made to engage diverse audiences and people with varied interests and perspectives through posters and social media posts.

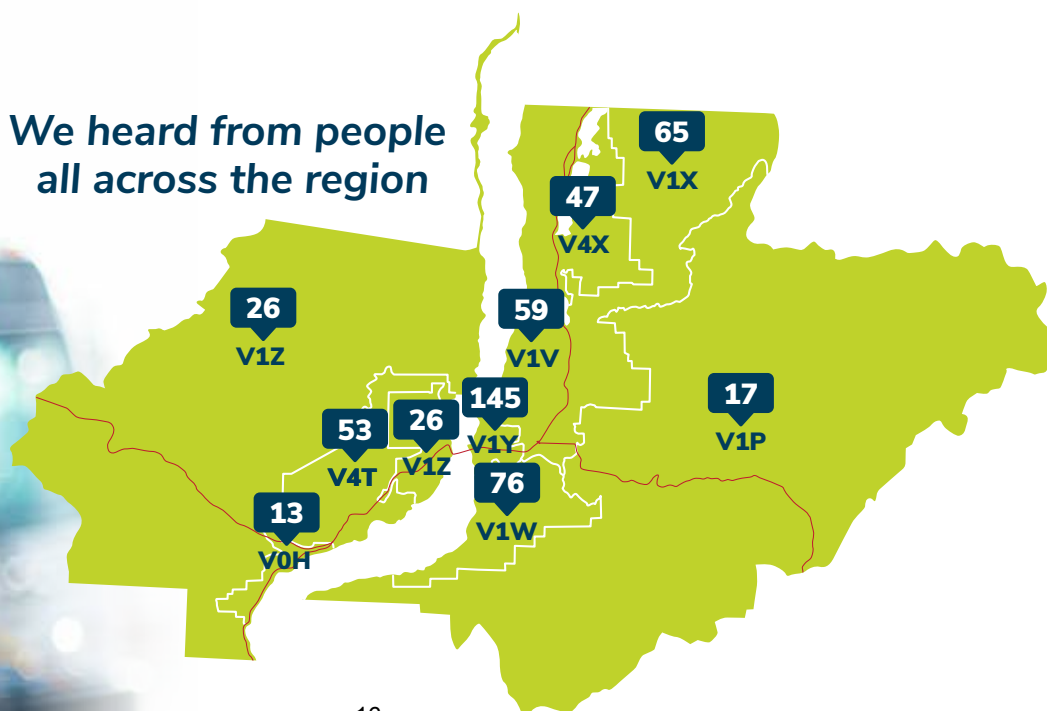
A shuttle bus was offered to residents of Peachland, West Kelowna and Westbank First Nation to facilitate their participation in the conversation held at UBCO. The bus was promoted to registered participants through the on-line event registration page and through each community's social media channels.



Participation

People from communities across the Central Okanagan region participated in the Let's Talk Transportation conversation held at UBCO and responded to the online questionnaire. Participants in the conversation included representatives from a wide variety of local organizations, geographic areas, students, seniors, people with diverse abilities, and elected officials. The geographic distribution of questionnaire respondents mirrored the distribution of population by region.

**We heard from people
all across the region**



"The traffic lights, and timing of them, need to be looked at. I am finding the lights are impeding traffic flow."

What we learned: At-a-glance

Through the conversation and questionnaire, residents of Peachland, West Kelowna, Westbank First Nation, Kelowna, Lake Country and the Central Okanagan East and West Electoral Areas told us what they think would make travel around the region more accessible, convenient and enjoyable. Here's what we learned:

People want to see:

- More transit and active transportation (biking and walking) options
- Increased efficiency in the existing road network (this includes optimizing bridge capacity)
- An increase in transit frequency and hours of service
- An active transportation network separated from vehicle traffic
- Safe walking and biking routes to school
- Ride hailing (e.g. Uber) and carshare (e.g. Modo)
- New housing near transit and employment centres
- Medical and other services located closer to home
- Policies that encourage working from home or shifting hours of work (to reduce vehicles on the road)
- Affordable and accessible transportation choices for people of all income and with diverse abilities
- Consideration of the climate impacts of transportation choices

The results indicated lower support for:

- Pricing strategies such as congestion pricing

"Glenmore's connection to Highway 97 in Lake Country desperately needs an upgrade."

"Accessibility means more than wheelchair friendly. I can't walk very far and I can't stand very long so if a bus doesn't get close to where I need to go, I can't use it."

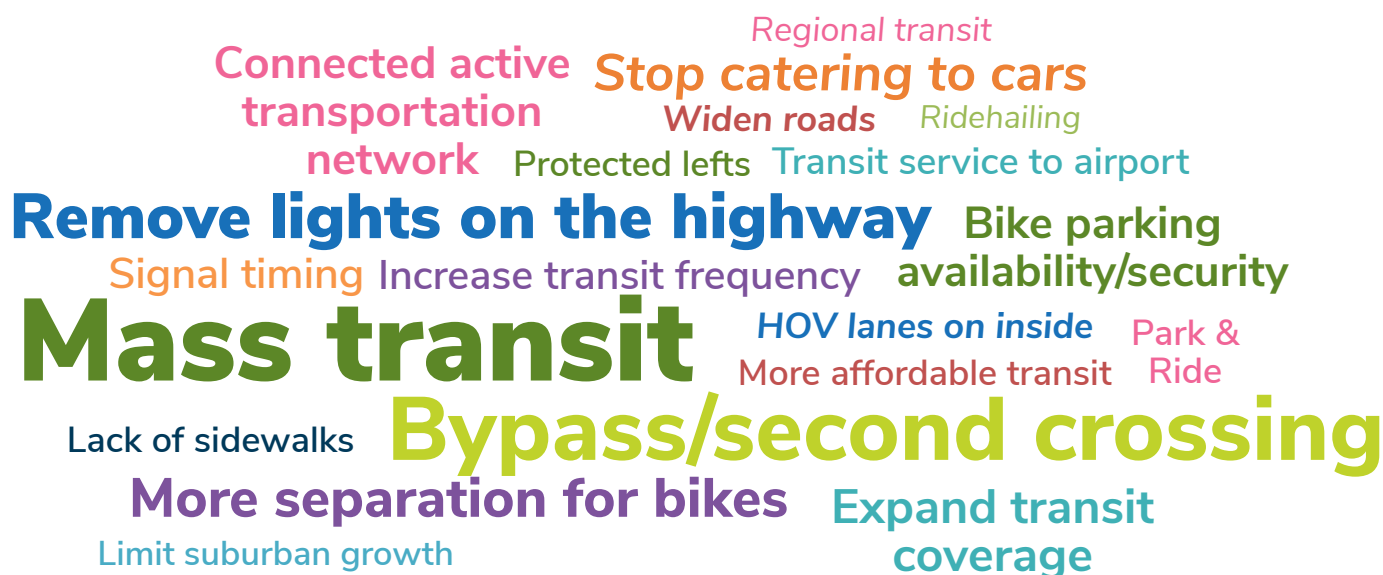
What do you dream about?

Each community in the region has unique transportation challenges that affect people's ability to connect to jobs, health care, education, and other services across the region.

Through short, visual stories, we introduced conversation participants to some of these challenges — and then we asked them to create coloured banners showing the transportation solutions that would make their lives easier. Here are some of the things conversation participants dream about:



Questionnaire respondents provided more than 1600 open-ended comments. Here are some of the priorities we heard:*



We also heard about the importance of providing affordable and accessible transportation choices for people with diverse abilities. Comments from participants to the Let's Talk Transportation conversation include:

- Improve handyDART
- Ensure bicycle lanes are wide enough for mobility aids such as recumbent bikes and scooters

* Responses were grouped into categories and tallied. Font size roughly corresponds with frequency of mention.

What we learned:

Potential transportation solutions by category

Questionnaire respondents indicated a high level of support for more frequent transit, safe walking and biking routes to school, separated bikeways, ride hailing and car sharing programs, and reducing cars by telecommuting or working from home.

RESULTS KEY: ■ Very supportive ■ Somewhat supportive ■ Not sure ■ Not supportive



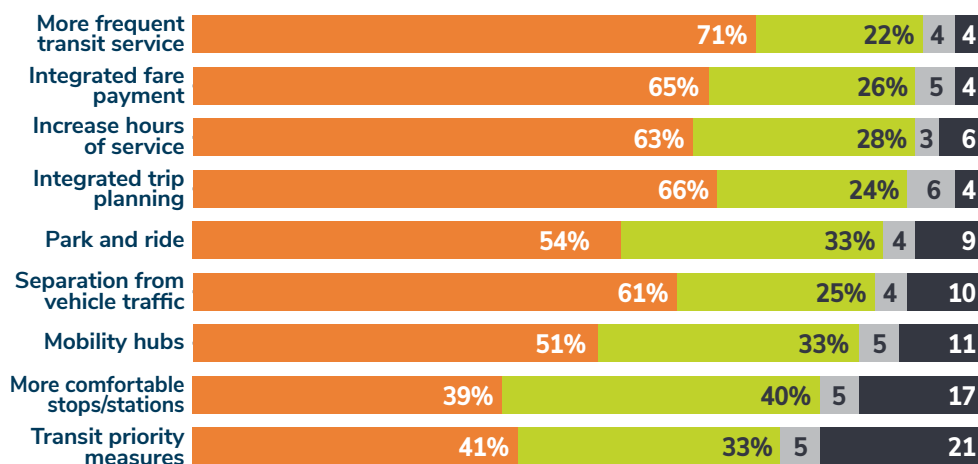
Transit

Respondents were asked, "How supportive are you of the potential transportation solutions listed below that aim to improve regional travel by transit?"

93% support* more frequent transit service

91% support integrated fare payment and increasing hours of service

90% support integrated trip planning (one app for multiple modes)



* respondents indicated 'very supportive' or 'somewhat supportive'



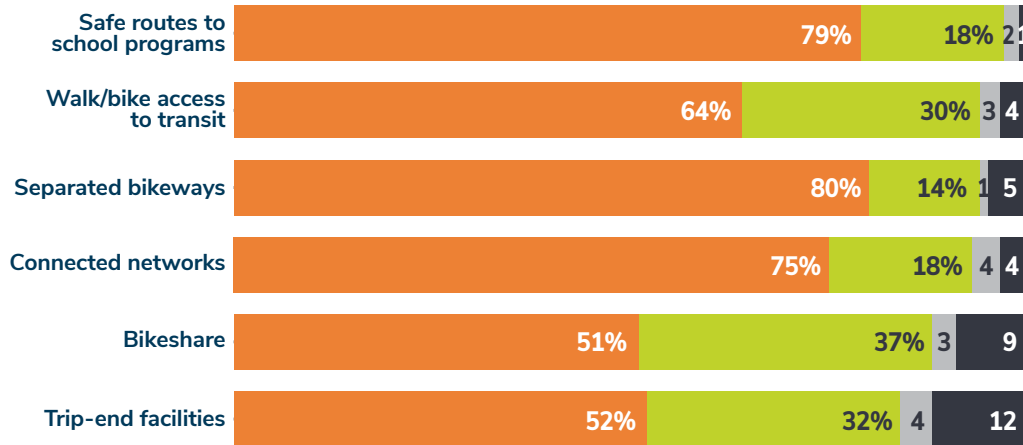
Active transportation

Respondents were asked “How supportive are you of the following potential solutions that aim to improve regional travel by walking or biking?”

97% support safe routes to school programs

94% support walk/bike access to transit

94% support separated bikeways



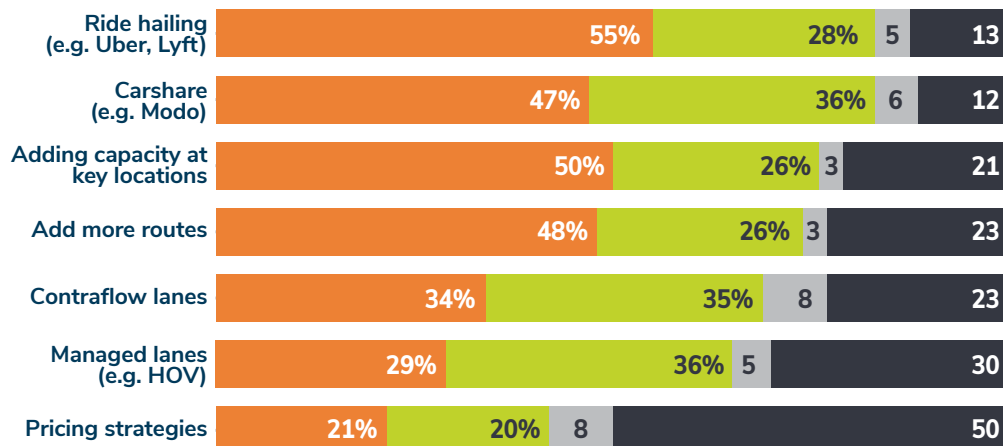
Vehicles

While providing convenient regional connections by transit, biking and walking are important, many regional trips will still need to be made by vehicle, whether for goods movement, emergency/evacuation purposes or private travel. Respondents were asked “How supportive are you of the following potential solutions that aim to improve the efficiency of regional travel by vehicle?”

83% support ride hailing

83% support carshare

76% support adding capacity at key locations





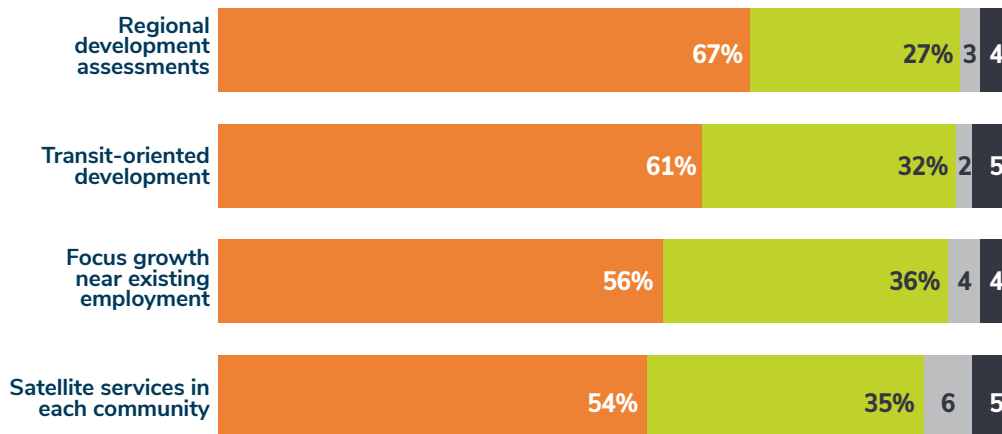
Land use and development

Land use and development patterns can determine how far we need to travel and the convenience of various travel modes for reaching destinations. Respondents were asked “How supportive are you of the following potential solutions that aim to improve regional travel using land use and development strategies?”

94% support regional development assessments (to assess the travel impacts of proposed developments)

93% support transit-oriented development (higher density around transit nodes)

92% support focused growth near existing employment



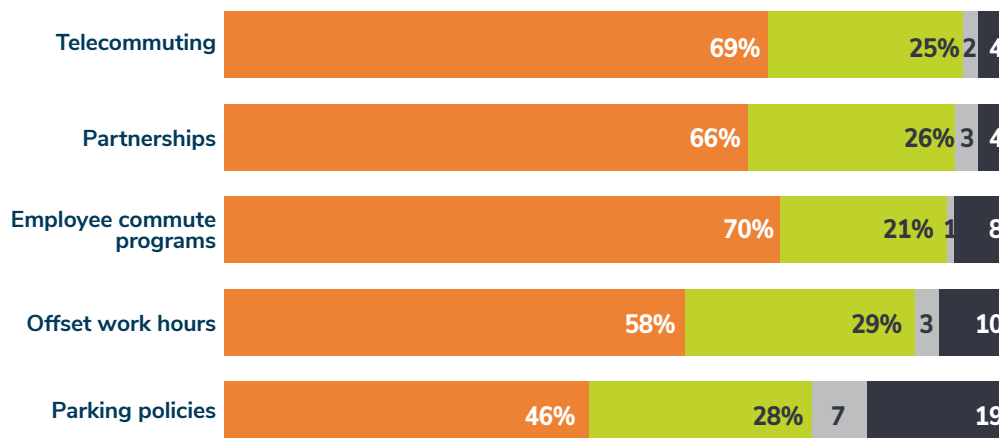
Trip reduction and elimination

Travel Demand Management refers to programs or policies that reduce the need to travel by single-occupancy vehicle during congested times of day. Respondents were asked “How supportive are you of the following Travel Demand Management strategies?”

94% support telecommuting

91% support employee commute programs

87% support offset work hours



What we learned:

Potential transportation solutions by geographic area

To facilitate more specific and detailed input, the Central Okanagan was divided into geographic areas and people were asked to indicate their level of support for potential transportation solutions in each area. They were also asked to share their own ideas about ways to make transportation around the region more accessible, convenient and enjoyable.

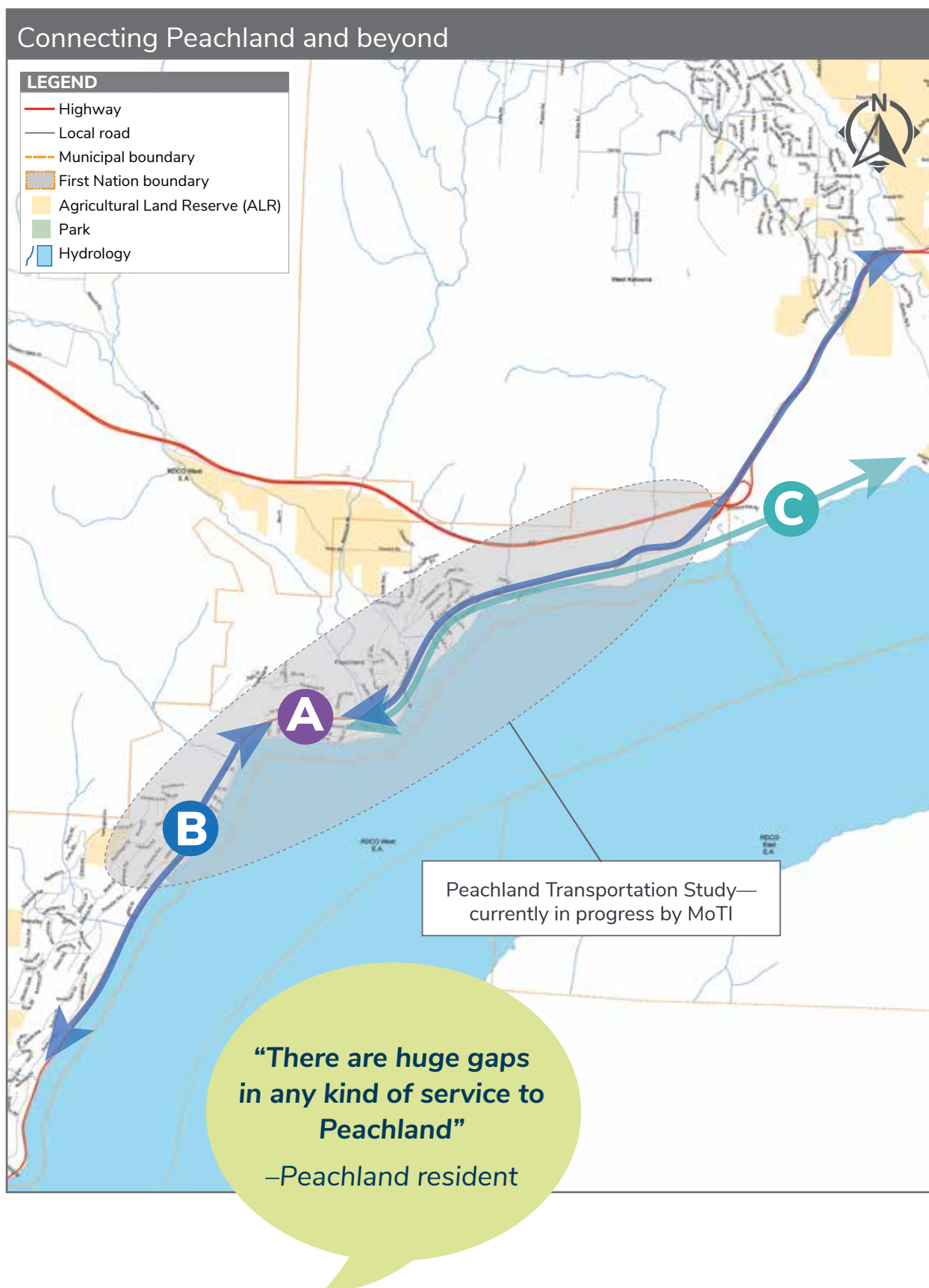


▲ During the conversation at the Let's Talk Transportation event, participants added comments and ideas to large maps

*How supportive
are you of
these ideas to
improve regional
transportation?*

Using geographic area maps and descriptions, conversation participants and questionnaire respondents provided comments and indicated their level of support for potential transportation solutions.

Results from each of these geographic areas are presented in the pages that follow.



Connecting Peachland and beyond

A. Transit / Mobility Hub (location TBD)

- Centralized transit station with connections north and south, and potentially to other modes of transportation (car/bikeshare, local transit, park and ride, etc.)
- Creates a centralized point to connect to longer distance transit trips

Very Supportive: **63%**
Somewhat Supportive: **27%**
Not supportive: **5%**
Not sure: **5%**

B. Transit Connections North and South

- Enhanced transit routes connecting to the north and south through Peachland, including potential extension of RapidBus
- Provides a direct transit connection from Peachland to the rest of the region

Very Supportive: **61%**
Somewhat Supportive: **28%**
Not supportive: **5%**
Not sure: **6%**

C. Westside Trail

- Multi-use walking and bicycling trail along the lake that would connect Peachland to the W.R. Bennett Bridge (alignment TBD), ultimately forming part of the Trail of the Okanagans
- Provides a safe and comfortable regional pedestrian and bicycling route for all ages and abilities

Very Supportive: **70%**
Somewhat Supportive: **21%**
Not supportive: **6%**
Not sure: **3%**

What other ideas do you have?

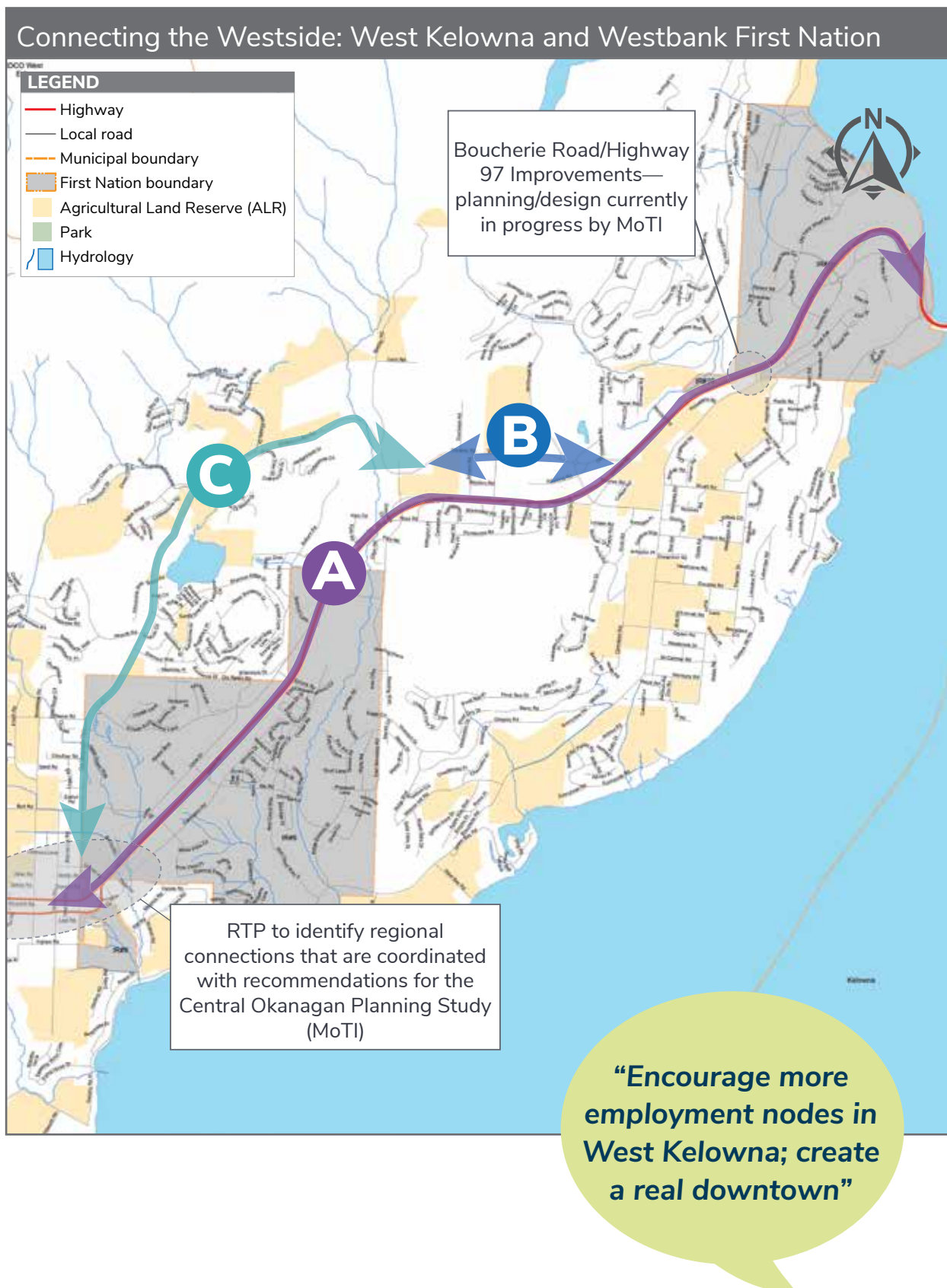
Other ideas from conversation participants and questionnaire respondents include:

Projects

- Pedestrian over or underpass into the town centre
- A park and ride (possibly at Antlers Beach)
- Improved handyDART service
- Light Rail – Peachland to UBCO
- A seabus/water taxi or float plane that connects to a transit hub
- An hourly connection to Kelowna with a rapid bus/train
- A Highway 97 bypass around Peachland
- Move proposed transit hub in Option A to downtown Peachland

Programs and policies

- Bikeshare
- A community health nurse or doctor in the community — to reduce the number of trips to Kelowna General Hospital
- Education and encouragement to use sustainable modes of travel
- Increase the frequency and reliability of transit service



Connecting the Westside: West Kelowna and Westbank First Nation

A. Highway 97 Dedicated Transit Lanes

- Transit running on the shoulder or in dedicated transit lanes in the median, supported by park and ride and/or other mobility options that make it easier to get to/from transit
- Allows transit to bypass congestion on the highway providing travel-time advantage and increased reliability for transit

Very Supportive: **55%**
Somewhat Supportive: **25%**
Not supportive: **17%**
Not sure: **3%**

B. Stevens Road Capacity Expansion

- Additional lanes and access management measures on Stevens Road
- Provides additional east-west capacity in the area

Very Supportive: **41%**
Somewhat Supportive: **34%**
Not supportive: **14%**
Not sure: **11%**

C. Shannon Lake Road Transit Enhancements

- Transit priority intersection treatments
- Allows buses to pass queued vehicles and provides better transit travel times and reliability as traffic volumes grown in this corridor

Very Supportive: **46%**
Somewhat Supportive: **32%**
Not supportive: **11%**
Not sure: **10%**

D. Westside Trail

- Multi-use walking and bicycling trail along the lake that would connect Peachland to the W.R. Bennett Bridge (alignment TBD), ultimately forming part of the Trail of the Okanagans
- Provides a safe and comfortable regional pedestrian and bicycling route for all ages

Very Supportive: **69%**
Somewhat Supportive: **21%**
Not supportive: **7%**
Not sure: **3%**

What other ideas do you have?

Other ideas from conversation participants and questionnaire respondents include:

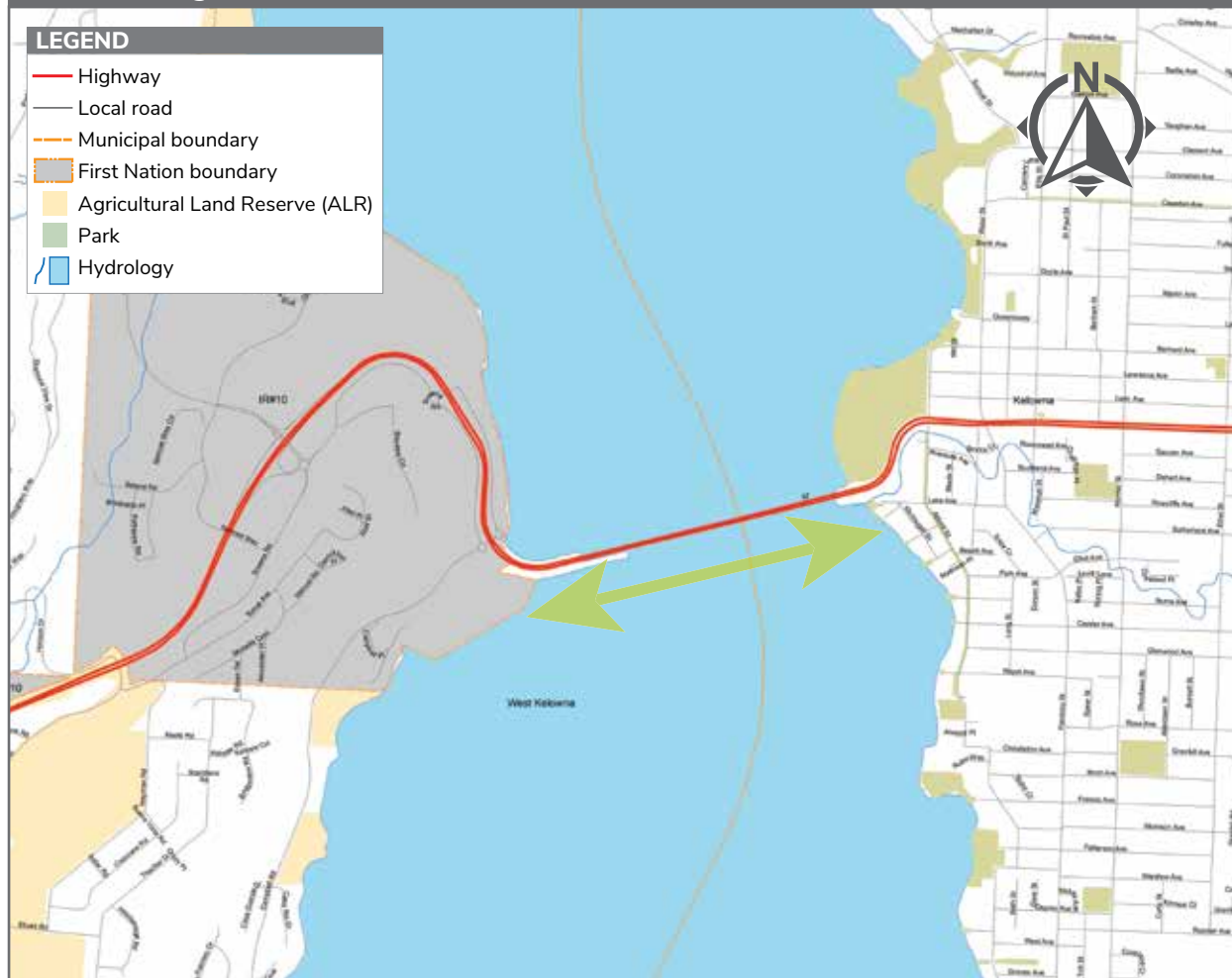
Projects

- Replace traffic lights on highway with interchanges
- A separated east-west bike route running either along Highway 97 or to the north
- Light rail transit along Highway 97
- Add more sidewalks and lighting (e.g. Elliott Road, Shannon Lake Road, Hudson Road)

Programs and policies

- Agricultural routes for farm equipment
- Add more services and employment on the Westside
- Land use decisions that limit sprawl
- Improve transit hours of service, frequency, reliability, and security at bus stops

Connecting across the lake



What other ideas do you have?

Other ideas from conversation participants and questionnaire respondents include:

Projects

- Park and ride / park and bike
- Gondola (with park and ride)
- Light rail on Highway 97 and bridge
- Real-time trip information/ electronic signs
- Bridge toll or mobility pricing
- Dynamic lane assignment on the bridge
- A second crossing
- Remove the lights on approaches to the bridge

Programs and policies

- Westside health centre, to reduce trips to Kelowna
- More employment on the Westside
- Shift employees' hours of work

Connecting across the lake

A. Reversible contra-flow lane

- The middle lane would become reversible (allowing 3 lanes of eastbound travel in the morning and 3 lanes of westbound travel in the afternoon). This is similar to the operation of the old bridge, but could be achieved with a movable barrier

Very Supportive: **46%**
Somewhat Supportive: **33%**
Not supportive: **20%**
Not sure: **2%**

B. Reversible contra-flow lane dedicated to transit

- Same as above, however the third lane in each direction would be a transit-only lane, providing travel-time advantage for transit

Very Supportive: **33%**
Somewhat Supportive: **24%**
Not supportive: **39%**
Not sure: **4%**

**“Park and ride option
at bridge lake ends is
a great idea!
It’ll allow folks to
park and bike too.”**

C. New dedicated shoulder transit lane

- This option would either convert an existing shoulder lane to be a dedicated contra-flow transit lane, or convert the existing active transportation pathway to a transit lane and redevelop the pathway in another manner

Very Supportive: **38%**
Somewhat Supportive: **26%**
Not supportive: **30%**
Not sure: **6%**

D. High frequency bus

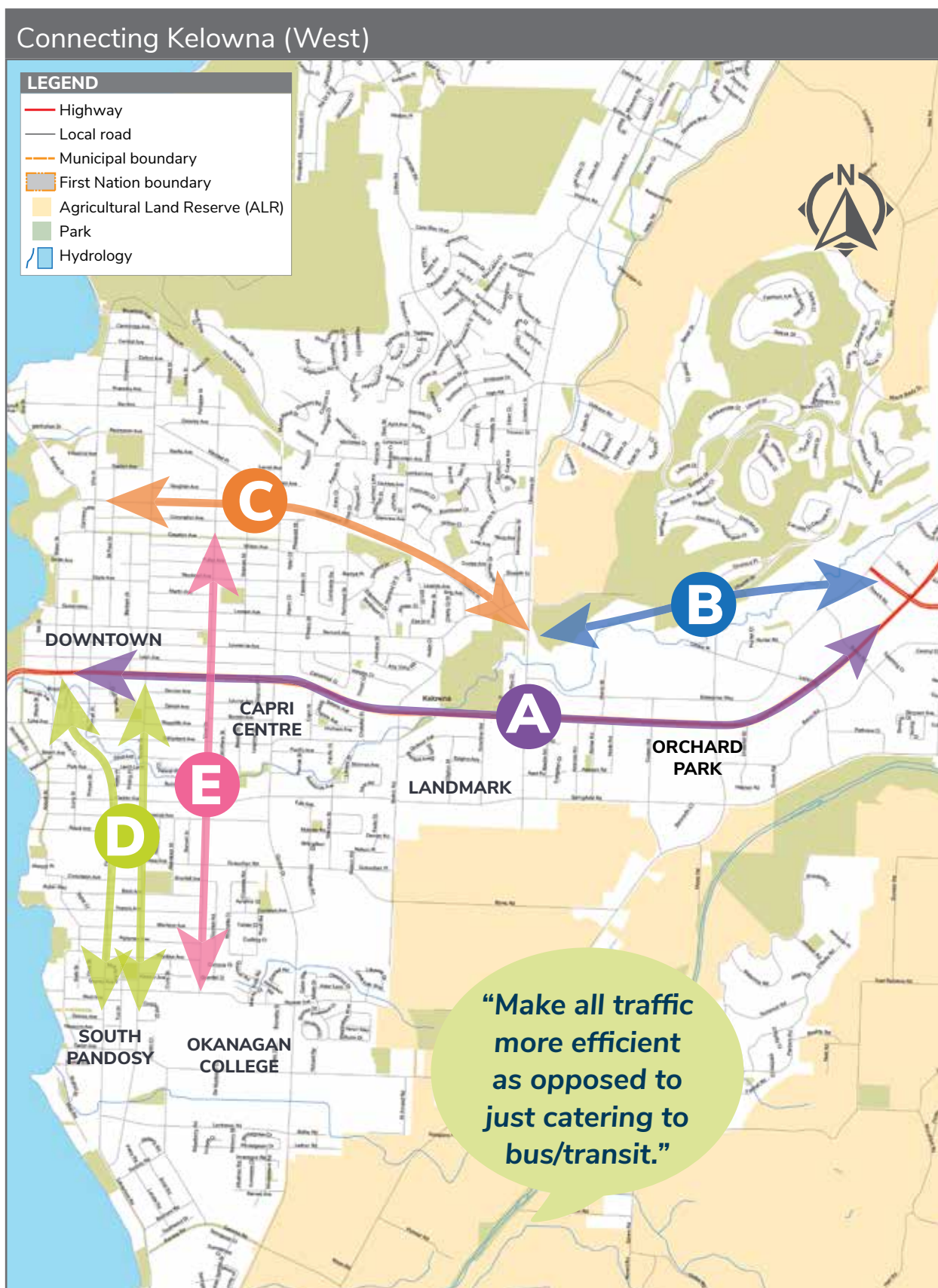
- Very high frequency bus across the lake combined with first/last mile options
- A shuttle-bus service with park and ride and shared mobility options at either end of the lake

Very Supportive: **42%**
Somewhat Supportive: **35%**
Not supportive: **17%**
Not sure: **7%**

E. Water taxi / ferry

- This option would include a ferry boat or water-taxi across the lake with park and ride and shared mobility options at either end

Very Supportive: **37%**
Somewhat Supportive: **27%**
Not supportive: **30%**
Not sure: **7%**



Connecting Kelowna (West)

A. Highway 97 Dedicated Transit Lanes

- Dedicated lanes for transit – could be either in the median or curb lane
- Provides travel time advantage and reliability for transit

Very Supportive: **42%**
Somewhat Supportive: **29%**
Not supportive: **26%**
Not sure: **2%**

B. Central Okanagan Multi-Modal Corridor (COMC)

- Extension of Clement Avenue to Highway 33, which could potentially include RapidBus and transit priority infrastructure
- Provides a multimodal alternative corridor to Highway 97

Very Supportive: **64%**
Somewhat Supportive: **24%**
Not supportive: **9%**
Not sure: **3%**

C. Clement Avenue Transit Priority or Dedicated Transitway

- Transit priority infrastructure or dedicated transit-only lane (that could potentially be converted to light rail in the longer-term)
- Provides travel time advantage and reliability for transit

Very Supportive: **45%**
Somewhat Supportive: **32%**
Not supportive: **16%**
Not sure: **7%**

D. Richter and/or Pandosy Transit Enhancement

- Transit priority treatments at intersections (e.g. transit queue jumps signal priority)
- Allows buses to pass queued vehicles, providing transit travel time advantage and reliability

Very Supportive: **48%**
Somewhat Supportive: **34%**
Not supportive: **13%**
Not sure: **5%**

E. Ethel Street Active Transportation Corridor Extension

- Extension of the Ethel Street active transportation corridor south of Highway 97 to Okanagan College
- Creates a continuous north-south pedestrian and bicycling corridor and connections to other regional pathways

Very Supportive: **63%**
Somewhat Supportive: **24%**
Not supportive: **8%**
Not sure: **4%**

What other ideas do you have?

Other ideas from conversation participants and questionnaire respondents include:

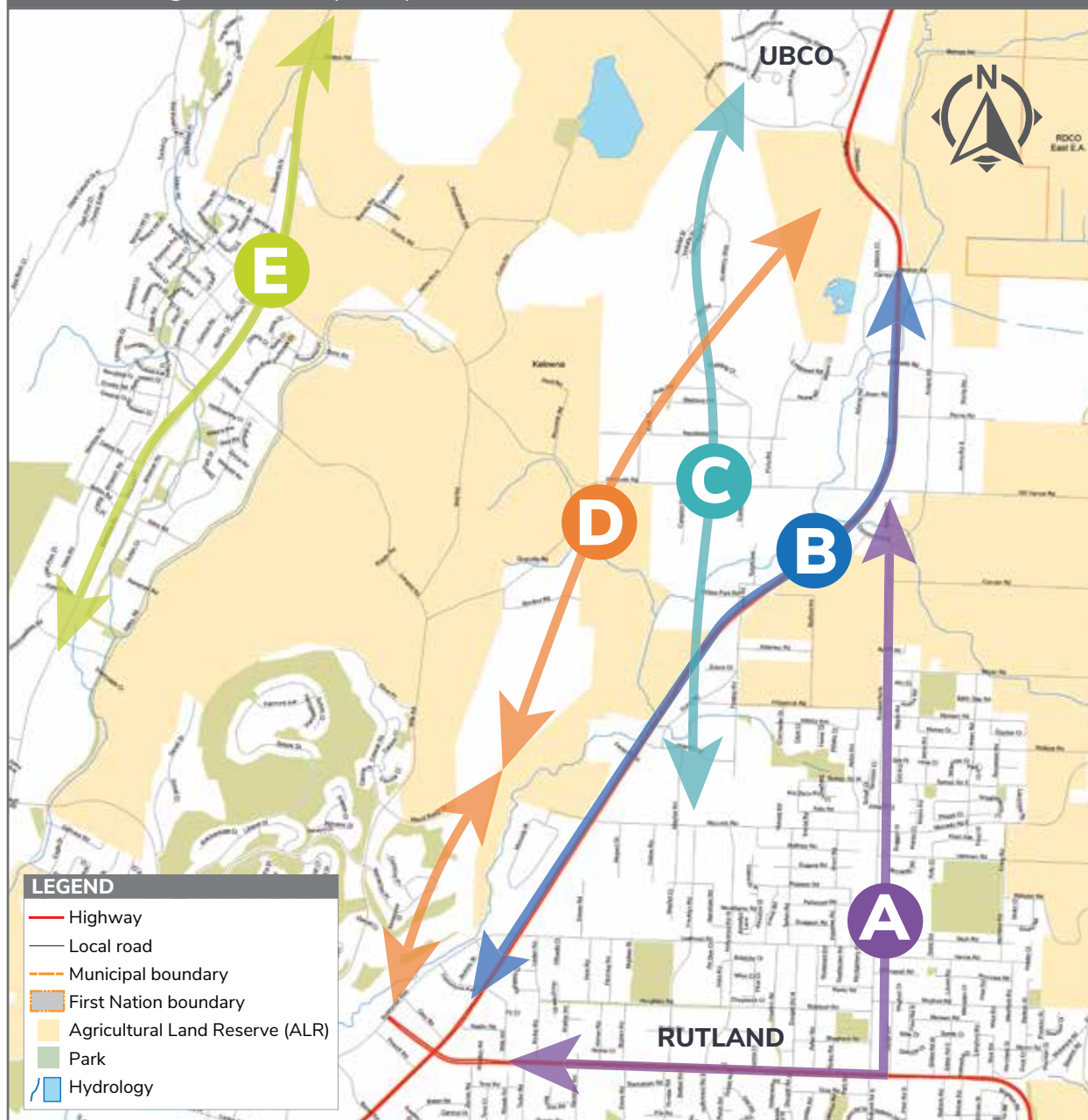
Projects

- Move or remove HOV lanes on Highway 97
- More pedestrian overpasses on Highway 97

Programs and policies

- Protected left turns at more places on Highway 97
- Education/awareness campaign focused on sharing the road
- Improved sweeping and plowing of bike routes

Connecting Kelowna (East)



Other ideas from conversation participants and questionnaire respondents include:

Projects

- Add more access points and better lighting to Okanagan Rail Trail
- Improve transit connections to UBCO
- Grade separated transit along highway i.e. Skytrain
- Fill gaps in local bike network

Programs and policies

- Add more options for people to walk, bike and take transit rather than build new roads
- Allow commercial vehicles or HOVs to use Highway 97 dedicated transit lanes
- Expand transit coverage to outlying areas (e.g. Black Mountain, Southeast Kelowna and Sexsmith Industrial Area)

What other ideas do you have?

Connecting Kelowna (East)

A. Highway 33 / Rutland Road Transit Priority

- Transit enhancements such as transit queue jumps and transit priority at signals to improve transit on Highway 33 and Rutland Road
- Reduces delays and improves reliability of transit along these routes

Very Supportive: **50%**
Somewhat Supportive: **31%**
Not supportive: **14%**
Not sure: **6%**

“An alternate route through town is badly needed.”

B. Highway 97 Dedicated Transit Lanes

- Transit-running on the shoulder or in dedicated transit lanes in the median
- Creates dedicated space and time advantage for transit

Very Supportive: **47%**
Somewhat Supportive: **21%**
Not supportive: **28%**
Not sure: **4%**

C. Hollywood Road Extension and Transit Priority

- New network road connecting Hollywood Road to UBCO, including infrastructure to improve transit operations
- Enables access to new development and a more direct connection to UBCO for all modes, including transit

Very Supportive: **49%**
Somewhat Supportive: **29%**
Not supportive: **12%**
Not sure: **10%**

D. Central Okanagan Multi-Modal Corridor (COMC)

- New roadway parallel to Highway 97 that could be a highway or major local street
- Could connect from McCurdy to Highway 33 (shorter arrow) or from the UBCO area to Highway 33 (long arrow)
- Provides an alternate corridor that diverts traffic from Highway 97; could be a priority transit route

Very Supportive: **68%**
Somewhat Supportive: **18%**
Not supportive: **11%**
Not sure: **4%**

E. Glenmore Road Improvements for all Modes

- Extension of four-laning to John Hindle Drive, separated pathway for full length and transit priority infrastructure (e.g. queue jump lanes)
- Provides a comfortable corridor for walking and biking while addressing increased travel demand for vehicles and transit

Very Supportive: **77%**
Somewhat Supportive: **16%**
Not supportive: **4%**
Not sure: **3%**



Connecting the Gateway

A. Acland-Bulman Connection

- Connection between the north end of Acland Road and the airport
- Creates a new, direct road connection between Rutland Road and the Airport, as an alternative to Highway 97

Very Supportive: **53%**
Somewhat Supportive: **30%**
Not supportive: **13%**
Not sure: **4%**

B. Improved Highway 97/Airport Access

- New or upgraded access from Highway 97 to and from the Airport (e.g. an interchange or series of connections)
- Addresses intersection safety issues and limited capacity of the current traffic signals to accommodate future traffic growth

Very Supportive: **67%**
Somewhat Supportive: **25%**
Not supportive: **5%**
Not sure: **2%**

C. Shared-use of the Former Rail Corridor

- Shared use of the Okanagan Rail Corridor by active transportation and other specialized modes such as transit or shuttles
- Opportunity for 'creative' use of space that provides a multi-modal alternative to Highway 97

Very Supportive: **53%**
Somewhat Supportive: **21%**
Not supportive: **22%**
Not sure: **4%**

D. RapidBus Extension to the Airport

- High quality transit, such as RapidBus service extension to the airport
- Makes transit a more viable option for Airport employees and passengers

Very Supportive: **69%**
Somewhat Supportive: **22%**
Not supportive: **7%**
Not sure: **3%**

E. Internal Gateway Connectivity

- Increased travel options between UBCO, the Airport and within the Okanagan Gateway through options such as micro-transit, shuttles and shared mobility options (car share, bikeshare, scooter share, etc)

Very Supportive: **53%**
Somewhat Supportive: **30%**
Not supportive: **11%**
Not sure: **6%**

What other ideas do you have?

Other ideas from conversation participants and questionnaire respondents include:

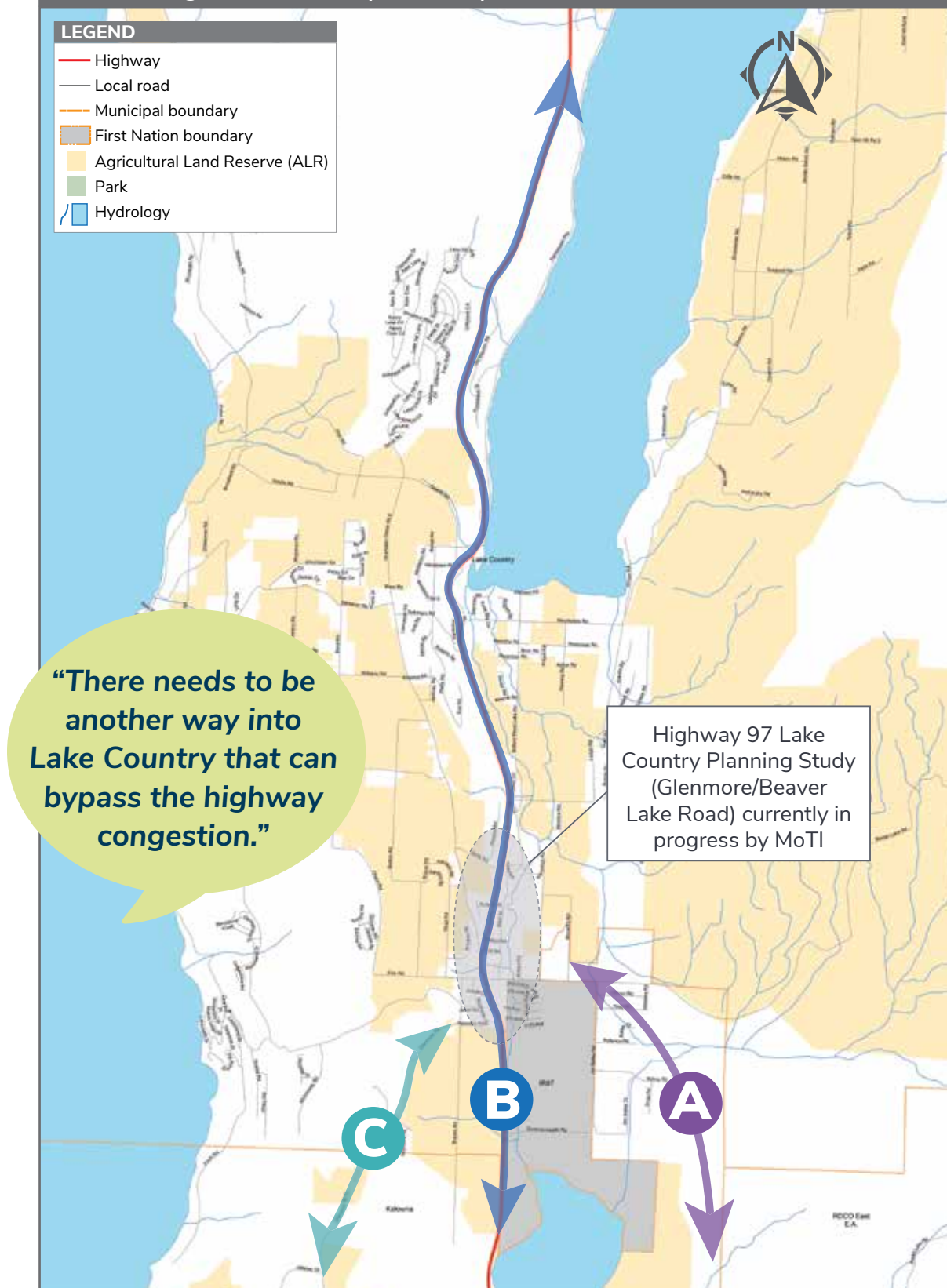
Projects

- Better connection for walking from nearby hotels and services to the airport
- Extend 3-laning of Highway
- Should be an eastern route to/from Lake Country (i.e. extension of the Jim Bailey Industrial Park Connection further south)
- Dedicated right-of-way for transit – make it more attractive, reliable, faster
- Elevated rail system along the rail trail corridor
- Transit service for seasonal agricultural workers

Programs and policies

- Rail Trail should be protected for walking, biking or potentially small electric vehicles
- Move stops for intercity buses closer to UBCO
- Congestion pricing
- E-bikes/bikeshare/scooter share
- Shift work hours to reduce peak period travel
- Incentives to leave car at home

Connecting Lake Country and beyond



Connecting Lake Country and beyond

A. Jim Bailey Industrial Park Connection

- Industrial road connection between Jim Bailey Industrial Park and the Airport
- Provides a more direct connection for industrial traffic and is an alternative to Highway 97

Very Supportive: **57%**
 Somewhat Supportive: **22%**
 Not supportive: **11%**
 Not sure: **10%**

B. Expanded Service to Lake Country and Beyond

- Extension of the RapidBus or other similar service to Lake Country (e.g. along Highway 97 or Glenmore Road), as well as expanded transit service north to Vernon
- Improves transportation options for Lake Country residents

Very Supportive: **65%**
 Somewhat Supportive: **24%**
 Not supportive: **8%**
 Not sure: **3%**

C. Glenmore Road Upgrades and Active Transportation

- “Spot” improvements to straighten curves and improve intersections, as well as better bicycling and pedestrian facilities
- Maintains Glenmore Road as a multi-modal alternative to Highway 97

Very Supportive: **77%**
 Somewhat Supportive: **17%**
 Not supportive: **4%**
 Not sure: **2%**

What other ideas do you have?

Other ideas from conversation participants and questionnaire respondents include:

Projects

- Better road connection between Glenmore and Okanagan Centre Road East
- Expand vehicle capacity at Highway 97 and Beaver Lake Road
- Widen Highway 97 in Winfield
- Complete the Rail Trail connection to Kelowna, consider paving in future
- Transit hubs and/or park and rides
- Light rail connection north and south
- Improved active transportation and rail trail connections
- Elevated corridor from Westbank First Nation to Lake Country (no lights)

Programs and policies

- Consider removing Oyama stops to Route 90 – Vernon Connector
- Carpool programs, app for ride share
- Bikeshare at key transit stops
- Congestion tolls
- E-bus stop in Lake Country
- Intercity bus stops

Shaping the future of the Central Okanagan

Thanks to all the people who have taken the time to support the engagement process for the Central Okanagan's first region-wide transportation plan. The community input to the Let's Talk Transportation conversation and questionnaire, along with technical and financial evaluations, will help identify the priority projects, programs and policies that will shape the future of the Central Okanagan Region.

Here's what the community said about the engagement process:

96% of respondents said the information was clear and understandable

74% said they understood how public input will be used in the process

92% said that participating was a valuable experience

80% said they learned something new

Next steps

Since 2018, people from across the region have added their priorities and perspectives to the regional transportation planning process through questionnaires and in-person events including region-wide pop-up open houses and interactive small-group conversations and discussions. Early public and stakeholder input helped confirm the vision and goals for the project, and the Let's Talk Transportation conversation and questionnaire, along with technical and financial considerations, will help inform the evaluation of potential regional transportation solutions.







Governance & Services Committee

TO: Governance and Services Committee
FROM: Murray Kopp, Director of Parks Services
DATE: November 4, 2019
SUBJECT: Proposal to Identify Johns Family Nature Conservancy Regional Park as a Dark Sky Preserve

Purpose: To provide the Governance and Services Committee with information about the Dark-Sky Site Designation program of the Royal Astronomical Society of Canada (RASC) and a rationale for nominating Johns Family Nature Conservancy Regional Park as a Dark-Sky Preserve.

Executive Summary:

The Province of British Columbia currently boasts only two Dark-Sky Parks, which promote the reduction of light pollution, demonstrate low-impact lighting practices, improve the nocturnal environment for plants and wildlife, and protect and expand dark observing sites for astronomy. Johns Family Nature Conservancy Regional Park encompasses 405.8 hectares (1002.7 acres) within the South Slopes of the RDCO. In 2012, the RDCO signed a long-term (99 year) agreement with Central Okanagan Land Trust (COLT) to lease the land and establish a Management Plan (2014). With its large size, conservancy status, location adjacent to parcels of Crown land and provincial park, and minimal lighting and infrastructure, the park is perfectly poised to become the province's third dark sky preserve. Not only would the designation, if approved, be relatively simple to implement with our existing resources, but the designation would showcase a commitment to conservation in our quickly developing region and offers an opportunity for meaningful partnership with our provincial, NGO, Indigenous, and public partners as well as showing Central Okanagan residents that dark skies matter.

RECOMMENDATION:

THAT the Governance and Services Committee recommends the Regional Board support RDCO staff submitting an application through the Royal Astronomical Society of Canada for the nomination of Johns Family Nature Conservancy Regional Park as a Dark Sky Preserve;

AND FURTHER THAT the Governance and Services Committee recommends that the Regional Board approve the establishment of a Dark-Sky Preserve at Johns Family Nature Conservancy Regional Park with the receipt of confirmation of a successful application from the RASC.

Respectfully Submitted:

A handwritten signature in black ink, appearing to read "Murray Kopp".

Murray Kopp, Director – Parks Services

Approved for Committee's Consideration

A handwritten signature in black ink, appearing to read "Marilyn Rilkoff".

Marilyn Rilkoff, Deputy CAO

Prepared by: Isabella Hodson, Supervisor of Community Relations and Visitor Services

Implications of Recommendation:

| | |
|-----------------------------------|---|
| Strategic Plan: | The delivery of Visitor Services programming and events is part of the overall Parks Services being delivered to our residents and meets the strategic priorities of the Board, particularly through the sustainable communities and environment identified priorities. In addition, Regional Parks and the services provided support the other two priorities of transportation and mobility and economic development by making our region more liveable and attractive to outside business and through the provision of park amenities to support these priorities. |
| General: | The provision of Visitor Services programming as part of the Regional Parks service provides an avenue for engaging citizens to be more active and connect to nature; including scotobiology within our program purview provides a new and exciting avenue with which to engage our residents and visitors. |
| Financial: | There are no financial implications. The delivery of the Visitor Services portion of Regional Parks is accounted for within the RDCO 5-Year Financial Plans approved by the Regional Board each spring. Lighting is included within our Park Operations budget; dark sky designation will have only minimal if any impact on this budget. |
| Legal/Statutory Authority: | The delivery of the Regional Parks service and associated programming and services follows the Letters Patent for the Regional District. |

Background:

Dark-Sky Preserves, which include 3 separate designations in Canada (Dark-Sky Preserves, Urban Star Parks, and Nocturnal Preserves) each with their own set of requirements, create awareness of the importance of dark skies and provide accessible locations for amateur and professional ecologists and the general public to experience the naturally dark night sky. With its considerable size and conservation park status, along with RDCO's management plan (2014) that shows our commitment with Central Okanagan Land Trust (COLT) to not develop the park with infrastructure or lighting, Johns Family Nature Conservancy Regional Park is perfectly poised to become a Dark-Sky Preserve.

Dark-Sky preserves are a growing trend internationally. In addition to the Dark-Sky sites in Canada, countries all across the globe are making the decision to conserve our night skies. Dark-Sky sites can be found everywhere from the Tomintoul and Glenlivet – Cairngorms International Dark Sky Park in the Scottish Highlands, to Yeongyang Firefly Eco Park in South Korea, to Grand Canyon National Park in the United States. The Royal Astronomical Society of Canada (RASC) manages our country's Dark-Sky program. In order to receive RASC approval, a location must demonstrate control of local lighting, establish outreach programs aimed at the general public and neighbouring municipalities, and adopt good nighttime lighting practices. Johns Family Nature Conservancy Regional Park already adheres to the lighting guidelines in that it only has the original home site of Alfred and Nancy Johns which projects minimal ambient light from these buildings, nor are there plans to develop park infrastructure requiring lighting. The existing lighting at the home site can be readily changed to conform to RASC lighting standards with minimal effort and cost.

The RDCO Parks Visitor Services team is well placed to deliver educational programming and events within the park. In terms of astronomy, we already offer a Perseid Meteor Shower event that has run for two years at Kopje Regional Park and is scheduled to run again in 2020. Audience participation grows every year. We also offered a popular Creatures of the Night hike in July and August of 2019 in several park locations. In terms of school programming, we offer a plethora of environmental education programs. Adding a program about astronomy and the impact of light pollution on wildlife in the Okanagan would be well within our scope. Our event roster and staff resources are also able to handle a new event such as an annual Dark Sky

Festival, especially when harnessing the power of partner organizations who would be interested in being a part of the Dark Sky Preserve nomination process. We are also keen to nurture our partnership with Westbank First Nation (WFN), as our Indigenous peoples have their own star stories and mythology that they may wish to share during a dark-sky event or program.

The Dark-Sky preserve nomination of Johns Family Nature Conservancy Regional Park is supported by COLT. Many additional partnership opportunities exist, including WFN and BC Parks, which manages neighbouring Okanagan Mountain Provincial Park – which could itself become part of the Dark-Sky preserve should BC Parks choose. Johns Family Nature Conservancy Regional Park is also surrounded by Crown land, which could potentially be added to the dark-sky preserve in the future. Nearby wineries have also expressed interest in the proposal to COLT, and further work could be done with local businesses, developers, and homeowners to “turn off the lights,” so to speak, at night and model good lighting practices that support dark skies.

In terms of visitor entry, Johns Family Nature Conservancy Regional Park has a public portion with limited trails and also a much larger conservation area that is not accessible to the public without a permit. While the Dark-Sky preserve status would apply to the entire park, public access would not change. The park offers a small parking lot off a gravel road, which would be sufficient for amateur astronomers as well as park visitors. An annual festival or event, if taking place at the park, would require a shuttle bus and further consideration for parking. The park is currently open year-round, with hours ranging from 6:00 am to 11:00 pm in summer and 6:00 am to 6:00 pm in fall and winter. As a dark-sky preserve, the park would need to be accessible to astronomers at night. From a Park Operations perspective, this occasional and likely infrequent traffic could be of benefit to the community as it would discourage other nighttime public behaviours in the park. Access from the parking lot is exclusively on foot, and visitors would be required to remain within the public area of the conservancy, which would not hinder night sky viewing.

Johns Family Nature Conservancy Regional Park is home to a great many native species and provides critical habitat and movement corridors in the swiftly-developing Okanagan region of our province. Designating the park as a dark-sky preserve not only allows for the species to live in their natural habitat during the daytime, but it also conserves the equally important nighttime hours of their lives. Further, our local human residents and visitors can benefit from this designation and commitment to dark skies. Because urban light is now so abundant, an estimated 85 per cent of Canadians are unable to see more than a few stars. Creating a dark-sky preserve in the Okanagan provides an opportunity to change this and allows park visitors to experience of one nature’s great wonders: the scintillating night sky. Night skies are also often at their best during the fall and winter months, a period when our Okanagan tourism season slows down. Having a dark-sky preserve is a wonderful incentive to add to our roster of tourism opportunities outside of our peak summer months and offers a new avenue for local businesses, tourism operators, and government agencies to attract new audiences.

The establishment of a Dark-sky Preserve would be a partnership between RDCO Parks Services, local stargazers and astronomers, and neighbouring municipalities. Nominating Johns Family Nature Conservancy Regional Park as a Dark-sky Preserve would require the active support of all of these agencies and stakeholders. There are four principal requirements for a Preserve: compliance to the guidelines for outdoor lighting provided by RASC, accessibility, quality of the night sky, and, in our case, an active outreach program. We have the resources and commitment to provide both full access and an outreach program. Moving forward with the nomination of Johns Family Nature Conservancy Regional Park as a Dark-sky Preserve under the Canadian RASC program would be an audacious and forward-thinking action that showcases our commitment to preserving our beautiful Central Okanagan, including its magnificent night sky, for generations to come.

External Implications:

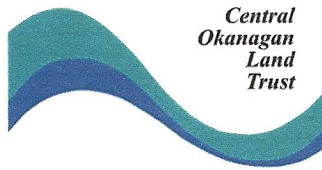
For a successful application, RDCO Parks Services would need the Board's support as well as the support of partner agencies and stakeholders, including COLT (already secured), WFN, and RASC. Additional potential partners include BC Parks' Okanagan Mountain Provincial Park and UBCO, as well as our neighbouring communities.

Alternative Recommendation: The Board could elect to simply receive the information and not support the application for the establishment of a Dark-Sky Preserve at Johns Family Nature Conservancy Regional Park.

Considerations not applicable to this report: None.

Attachment(s):

1. Letter of Support from Central Okanagan Land Trust
2. Guidelines for Outdoor Lighting (Low-Impact Lighting) for RASC Dark-Sky Protection Programs
3. RASC Preserve Application Requirements 2018



Regional District of Central Okanagan
1450 KLO Road
Kelowna , BC V1W 3Z4

Attn: Brian Reardon, CAO

Dear Brian,

At our regular Board of Directors meeting of the Central Okanagan Land Trust held in September our Regional District representative, Isabella Hodson, presented us with her most interesting proposal to nominate the Johns Family Nature Conservancy Regional Park as a Dark Sky Preserve. Our board was very intrigued with this idea and encouraged Isabella to move forward with her formal proposal.

At our October board meeting Isabella outlined in more detail her ideas and this past week provided a copy of her proposal.

The Central Okanagan Land Trust fully agrees and supports this unique initiative to create a Dark Sky Preserve on the Johns Family Regional Park. Our values of conservancy and stewardship align completely with objectives of the Dark Sky Preserve. This project will also provide an opportunity to showcase the value of conserving and protecting these natural areas and also be part of a global movement to preserve our night skies.

Please accept this letter as our full endorsement of this project.

Sincerely,

Gordon Savage
President
Central Okanagan Land Trust

#306 – 1726 Dolphin Avenue, Kelowna, BC V1Y 9R9
www.coltrust.ca

**Guidelines for Outdoor Lighting
(Low-Impact LightingTM)
for
RASC Dark-Sky Protection Programs
Dark-Sky PreservesTM
Nocturnal PreservesTM
Urban Star ParksTM**

**Adopted March 2008
Revised Spring 2016
Revised Autumn 2018**

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1.0 SCOPE

The goal of the RASC Dark-Sky Protection Program (Program) is to promote the reduction in light pollution, demonstrate good ecologically sound night-time lighting practices, improve the nocturnal environment of wildlife, protect and expand dark observing sites for astronomy, and provide accessible locations for the general public to experience the naturally dark night sky.

There shall be no installed artificial light within a Preserve. However if the manager deems it necessary, artificial lighting will conform to these guidelines.

This document presents Guidelines for Outdoor Lighting (GOL) to be used in, but not limited to, Dark-Sky PreservesTM, Nocturnal PreservesTM and Urban Star ParksTM herein after referred to as Preserves, and describes the types of equipment required to satisfy these guidelines. It refers to areas classified as “Lighting Zone 0, and Zone 1” (per IESNA-IDA Model Lighting Ordinance). LZ 1 has low ambient lighting levels such as small rural residential areas. LZ 0 encompasses areas that are sensitive to artificial lighting and other environmental disruptions.

This GOL has three objectives: to limit glare and the adverse ecological impact of artificial lighting throughout the Preserve, provide technical specifications for acceptable illumination levels required for safe navigation, and it presents lighting policies that may be applied to urban areas beyond the its boundaries. These will protect the Preserve from deterioration by surrounding light pollution.

In Section 3.0 we present the rationale for the protection of the rural and urban night environments from the excessive use of artificial lighting. To support these guidelines, this document provides references to useful web sites and to general research into the effects of nocturnal lighting on humans, flora and fauna. Additional information and references are published in the peer-reviewed paper by Dick¹:

The guidelines for outdoor lighting within Preserves are presented in Section 4.

A bibliography in Section 6 provides a set of references and useful websites. Supplementary technical information is provided in the appendices to this document.

Lighting hardware and signage are described in the Appendices to assist Park Managers in minimizing the impact of artificial lighting on the night environment while maintaining a degree of safety for visitors. These sections will also be useful to municipal officials who are tasked with reducing the ecological impact of urban infrastructure.

¹ Dick, R., Applied Scotobiology in Luminaire Design, Lighting Research and Technology, 2013; 0: 1-17, doi: 10.1177/1477153513505758

2.0 GLOSSARY

2.1 Acronyms

ALAN Artificial light at night

CARS Canadian Aviation Regulations

CFL Compact Fluorescent Lamps

CO Cut-off luminaires (>0% and <2% up-light)

FCO Full Cut-Off luminaires (0% up-light or “fully shielded”, 10% maximum in glare zone) where the glare zone is defined to be from 80° and 90° from nadir. This is the minimum level of shielding.

GOL RASC Guidelines for Outdoor Lighting

HID High Intensity Discharge lamps (LPS, HPS, MH lamps)

HPS High Pressure Sodium lamps (“yellow” coloured HID lamps)

IESNA Illumination Engineering Society of North America

LEDs Light Emitting Diodes

LILTM Low Impact LightingTM. Lighting that complies with these Guidelines

LPS Low Pressure Sodium lamps (monochromatic, single colour HID lamps)

LZ # Lighting Zone as per IESNA-IDA

MH Metal Halide lamps (“white” coloured HID lamps)

Preserve An area under single management that has been designated by the RASC as a Dark-Sky PreserveTM, Nocturnal PreserveTM or Urban Star ParkTM

SAD Seasonal Affective Disorder

SCO Semi-Cut-off luminaires (<2% up-light)

ShCO Sharp Cut-off luminaires (<0% up-light, <1% between 80-90 degrees of nadir)

2.2 Definitions

Amber – a colour of light that does not have any emissions at wavelengths shorter than 500 nm with a peak around 590 nm. Generally has a broadband yellowish colour and has less impact on night vision and circadian rhythm than other colours.

Dark Time – a period after which scheduled outdoor activity has ended and visitors are expected to minimize their activity to permit other visitors to sleep.

Preserve Buffer Zone - the region within the Preserve under control of the Preserve Manager, surrounding the Core area. The Buffer is designed to prevent glare and light trespass from shining into the Core area.

Preserve Core - the region under control of the Preserve Manager surrounded by the Buffer Zone.

Filter – filters the spectral components <500 nm from light to produce amber illumination (ref: Roscolux Deep Straw #15)

Foot-candles (fc) - – the illuminance metric in the Imperial units of lumens/foot². Examples of levels are provided in Appendices A and C.

Glare Zone - sector between the horizon (90° from nadir) and 10° below the horizon.

Incandescent lamps - Lamps with tungsten filaments

Lumens - A luminance metric unit for the amount of emitted light. Typical luminance of various lamps are listed in Appendix A and C.

Lux – the illuminance metric in the SI units of lumens/m². Examples of levels are provided in Appendix C.

Nadir - the point directly below the luminaire (opposite to zenith)

Photobiology – the study of the effects of light on biological systems

Photopic Vision – vision based on cone cells that have evolved for daytime vision and high illumination levels. Their peak sensitivity is at 555 nm.

Scotobiology – the study of the biological need for periods of darkness

Scotopic Vision - vision based on rod cells that have evolved for night vision and low illumination levels. Their peak sensitivity is at 505 nm.

Sky Quality Meter – a light meter designed specifically to measure a value for the brightness of the night sky.

White Light - Coloured light with combined spectral components of blue, yellow and red

3.0 RATIONALE

Most people take artificial night lighting for granted. In cities it is considered to be an acceptable component of our society, and indeed many people think it is necessary for safety and security while providing an aesthetic quality to the night. Specifications and guidelines for street and roadway lighting² address these urban assumptions. These have lead to lighting policies that encourage the illumination of all urban areas to allow the use of human photopic (daytime) vision in virtually all populated areas (Figure 3.0.1).

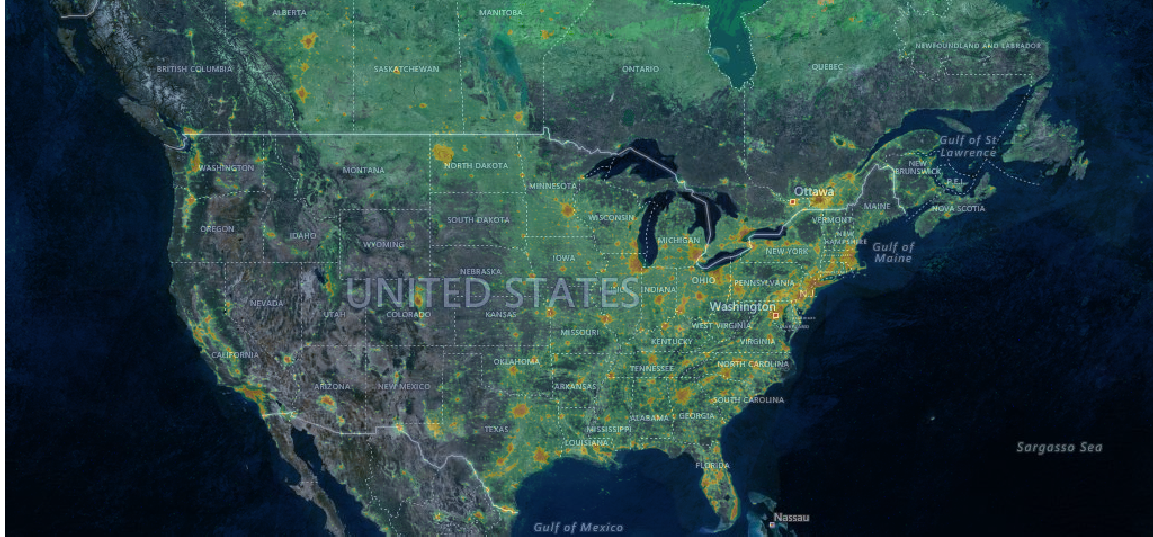


Figure 3.0.1 *Mid Latitudes at Night* (<http://www.lightpollutionmap.info> 2018)

The availability of electrical energy and efficient lighting fixtures have enabled the current urban lifestyle of non-stop “24-7” activity. Furthermore, the advances in lighting technology have permitted illumination levels to increase recently by about 2.2% per year³ and over the last 50 years by over a factor 10, with the use of the same amount of electrical energy. The result is that most commercial and consumer luminaires are designed for high levels of illumination. Low intensity fixtures are primarily limited to decorative lighting such as Christmas lights.

It is now common in a city to be able to read a newspaper at night under the city’s artificial sky glow. In Figure 3.0.2, the light polluted skies of Toronto are compared to good skies of Algonquin Park (upper left) that has very dark skies. Bright red corresponds to high levels of sky glow (0.010 lux) and green is an intermediate amount (0.000 4 lux).

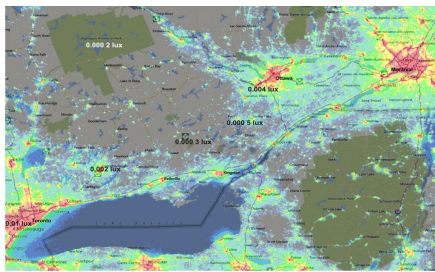


Figure 3.0.2 *Light Pollution in Southern Ontario. Illuminance (lux) values were converted from Sky Quality Meter readings made under clear skies between about 2010 and 2012. Most rural light comes from house and dusk-to-dawn lighting beside township roads and highways.* (<http://www.lightpollutionmap.info> 2010)

² Illumination Engineering Society of North American (IESNA) Handbook

³ C. Kyba, et.al., Artificially Lit Surface of Earth at Night Increasing in Radiance and Extent Science Advances 2017;3: e1701528 November 22, 2017, <http://advances.sciencemag.org/>

3.1 Crime

The most prevalent reason given for light at night is to reduce crime in cities. This is generally based on the notion that more light improves visibility, and this visibility discourages criminals. Based on studies of crime statistics before and after changes in outdoor lighting, there is no clear evidence that outdoor lighting reduces crime⁴. Although there are anecdotal reports that “improved lighting” (i.e. improved visibility) reduces crime⁵, there is no evidence that crime is reduced with “more or brighter lighting”⁶. In some cases crime was simply displaced, or the altered lighting was prompted or caused by a change in use of the streets by, “...strengthening informal social control and community cohesion”⁷ and this may have affected the pattern of crime.

There are different types of crime. Anecdotal studies report theft and property crime is more prevalent during daytime hours. The public’s belief in the prevalence of random violence (promoted by Hollywood films) is not supported by research. Further, violent crime more occurs more often in the evening and after midnight⁸ between persons that know each other. Random violence is widely reported in the media but it is generally quite rare.

There was an unconfirmed report that the brightly lit City of Manila found violent crime was still more prevalent on brightly lit streets after dark but increasing the presence of police was effective at reducing crime at night. The city lights were not the deterrent to crime whereas the visible presence of the police was. A comprehensive report to Congress, by the National Institute of Justice⁹ states that there is no evidence that artificial lighting deters crime. It reports that most studies are poorly designed and without controls, which undermines any conclusions to the contrary. The report states that: “We can have very little confidence that improved lighting prevents crime”. Furthermore, lighting can assist criminal activity by putting the victim on display. And, the perception of safety provided by the light may have the opposite effect by encouraging unsafe behaviour.

Vandalism is an example where security lighting has the opposite effect of what is generally believed. Studies conclude that lit areas are subject to more vandalism and graffiti. Anecdotal evidence¹⁰ and more focused studies¹¹ support the policy of turning

⁴ The Influence of Street Lighting on Crime and Fear of Crime, Prevention Unit Paper No. 28, Stephen Atkins, Sohail Husain and Angele Storey, 1991, ISBN 0 86252 668 X

⁵ Effects of Improved Street Lighting on Crime: A Systematic Review, Home Office Research Study 251, by David P. Farrington and Brandon C. Welsh, August 2002

⁶ The Indiana Council on Outdoor Lighting Education (ICOLE), P.O. Box 17351, Indianapolis, IN 46217

⁷ *ibid*, page 2.

⁸ www.bpap.org/bpap/research/DCA_briefing_dtd.pdf

⁹ National Institute of Justice Grant Number 96MUMU0019 (www.ncjrs.gov/works/)

¹⁰ “Darkened Streetlights Fail to Raise Crime Rate”, DesMoines Register, T. Alex and T. Paluch, May 6, 2004 www.dmregister.com

¹¹ Effects of improved street lighting on crime: a systematic review, Home Office Research Study 251, August 2002

lights off when security staff is not around. Apparently, vandals want to see the results of the damage and for others to see it.

“Security” is often given as a reason for a luminaire. However, it is not clear how these luminaires are used. What is being watched? A security light need only illuminate a particular area that is under surveillance. Otherwise “security lighting” only puts facilities on display, which may encourage vandalism.

Security is NOT the same as safety. Best practice for security lighting is based on urban crime. In most cases illumination in Preserves is used for visitor safety and navigation. This is a different approach to lighting and is provided by much less light. Lighting should be used only to highlight hazards, and only the hazards should be highlighted.

3.2 Lighting for Human Activities

Humans are a daytime species. Although we can see at night, our vision is significantly reduced compared to the daytime. In the past, starlight provided sufficient levels of illumination for most "pedestrian" activities. However our modern fast-paced and mechanized activity requires better visual acuity for driving cars, riding bicycles and for avoiding urban hazards.

The human reaction time to a stimulus is a function of the illumination level¹². For our photopic vision it is less than 0.2 seconds whereas with our scotopic (night) vision it is about 0.5 seconds, which is sufficient for a walking pace. However in the presence of illuminated roadside distractions, actual reaction times are from 1 to 3 seconds¹³. Illumination levels play only a small part in reducing driver reactions but significantly increase the visibility of distractions.

Some level of artificial lighting is required for activities at night. But this lighting must be designed to increase visibility. Paradoxically, more light can reduce visibility by creating glare, especially for persons over 40 years of age¹⁴.

Sensitivity to glare increases with age, as does our chances of developing cataracts. In the face of a bright light, our iris closes down letting light into the eye only through the centre of our lens. Since cataracts begin in the centre of the lens, the vision of senior citizens can be severely degraded by glare even without fully developed cataracts. With the aging of our population, it is becoming more important to reduce glare in urban environments.

¹² A.L. Robert - Simple Time Reaction as a Function of Luminance for Various Wavelengths, Perception & Psychophysics, 1971, Vol.10(6)

¹³ T. Triggs, W. Harris, Reaction Time of Drivers to Road Stimuli, Human Factors Report No. HFR-12, ISBN 0 86746 147 0, Monash University, Victoria Australia, June 1982

¹⁴ Work, Aging, and Vision: Report of a Conference, ISBN-10: 0-309-07793-1

3.3 Human Health

The proliferation of outdoor lighting has a significant impact on the health and behaviour of humans¹⁵. “Biological clocks control our sleep patterns, alertness, mood, physical strength, blood pressure, and other aspects of our physiology”¹⁶. The dominant mechanism for synchronizing this biological clock to our activity (the circadian rhythm) is the day-night contrast and the timely release of the hormone melatonin. This hormone regulates the ebb and flow of other hormones in our bodies that repair the daily damage our bodies suffer each day. Without the timely release of these hormones, healing takes longer and our bodies are less able to fend off disease¹⁷.

The timing or phase of the circadian rhythm also affects our behaviour. For example, Seasonal Affective Disorder (SAD) is an emotional condition experienced by travellers and others. The symptoms of SAD can be reduced with exposure to bright light¹⁸ in the morning as it shifts (or entrains) and resets our biological clock. However if this entrainment occurs during the late evening or at night due to artificial outdoor lighting, the biochemistry that controls our physiological well-being will also be shifted away from the optimum period.

3.4 Environmental Health

Although many people are familiar with the activity of the natural world during the day (i.e. photobiology), few people are as familiar with similar activity at night. Humans are not the only species whose biological clock is controlled by day-night contrasts and the release of melatonin. Similar biological clocks are found in plants and animals wherein darkness plays a similar role¹⁹. Wildlife depends on the darkness of the night and the study of this dependence is called “scotobiology”.

Research into the nocturnal environment is relatively recent compared to research into the daytime environment. This situation is changing with a growing body of literature documenting the sensitivity of the general ecology at night to artificial lighting. This mounting scientific evidence is documenting the profound impact of artificial light on the ecology of the night²⁰.

Plants are affected by the colour and duration of lighting. Whether the effects are considered beneficial or not depends whether the outcome is desired or not. Generally, artificial lighting will change the natural growth patterns and may affect the resistance of plants to infestations and disease. Many plants respond to the length of the night and normally recognize it as an indication of the season. Extending light past the evening may slow or prevent the ability of the plant’s biochemistry to prepare for winter. The various affects of light colour and duration, and type of plant, etc. makes sweeping conclusions

¹⁵ Light Research Organization, Electric Power Research Institute, (www.epri.com/LRO/index.html)

¹⁶ WebMD, March 06, 2007, www.webmd.com/cancer/news/20040908/light-at-night-may-be-linked-to-cancer

¹⁷ “Light at night and cancer risk”, Schernhammer E, et.al., *Photochem Photobiol.* 2004 Apr;79(4):316-8.

¹⁸ “Shutting Off the Night”, H. Marano, *Psychology Today*, Sep/Oct 2002

¹⁹ “Lighting for the Human Circadian Clock”, S. M. Pauley, *Medical Hypotheses* (2004) 63,588–596

²⁰ *Ecological Consequences of Artificial Night Lighting*, C. Rich, T. Longcore, Island Press, 2006, Pg. 405

impossible, however they indicate that changing the lighting environment will change the natural ecology of the area.

3.5 Animal Behaviour

Artificial sky glow extends well beyond the city boundaries. Therefore in considering urban outdoor lighting, city officials must also consider its impact on the rural areas in the region. As with air and water pollution, light pollution is not contained by political boundaries.

Exposure to short periods of bright illumination (less than a minute) does not seem to affect the biological rhythm in animals²¹. However, longer exposures to light can shift (or entrain) their circadian rhythm and can modify their behavioural patterns. Minimizing the duration of exposure to artificial light is necessary to limit its impact.

Seasonal variations will shift the time of sunset by over four hours at mid-latitudes from roughly 16:30 in winter to 21:00 in summer. During the peak of summer activities in public parks, the time of sunset can vary by over two hours (see Appendix D). In addition to this, dusk can extend the daylight by as much as an hour. The “behavioural plasticity” of animals has presumably evolved to accommodate these variations.

Natural lighting changes the behaviour of species at night²². Nocturnal mammals adapt their behaviour over the lunar month in sympathy to moonlight to avoid predators. This behaviour includes, in part, limiting the foraging area and carrying food back to their shelters instead of eating in the field - limiting how much they can eat²³. They compensate for this during the dark time of the month.



Predator and prey behaviour depends on the darkness of the night²⁴. Illumination levels that significantly affect our biology and that of wildlife is believed to be at the level of the full Moon, although the effect begins to be evident at lower light levels²⁵. To put this in context, it is generally recommended by the IESNA that an urban parking lot be lighted to more than 100X the brightness of the full Moon (see Appendix A), and the distant illumination by the sky glow from a nearby city can exceed full Moon levels.

An illuminated road may separate animals from their normal foraging grounds. When headlights from passing cars temporarily blind them, their natural instinct is to wait until they can see where they are going. This can leave them in the open and vulnerable to

²¹ Ecological Consequences of Artificial Night Lighting, C. Rich, T. Longcore, Island Press, 2006, Pg. 24

²² The Urban Wildlands Group (www.urbanwildlands.org/abstracts.html)

²³ Ecological Consequences of Artificial Night Lighting, C. Rich, T. Longcore, Island Press, 2006, Pg. 28

²⁴ *ibid.*, Chapter 2

²⁵ *ibid.*, Chapter 11

predation. They may eventually abandon their established foraging areas for new ones, which will impact the indigenous species as they compete for resources²⁶.

It is well documented that some insects are drawn towards light sources. This interrupts their normal mating and foraging activities and it concentrates them within a small area thus enhancing predation²⁷. They may also swarm the light fixture until they are exhausted. In a public park, the resulting pile of insects had to be cleaned up in the morning²⁸. The blue-light components of typical white light are the main light attractors for insects. Using white light essentially attracts the insects to the people causing a nuisance and, since insects are vectors for disease, the white light enhances the health risk of outdoor activity²⁹.

3.6 Shorelines

Waterways have been used for transportation and recreation. However, they are also important ecosystems that support wildlife in the water and on the lands adjacent to the shoreline. Shoreline property is valued by our society and this is causing human developments along rivers and around lakes. An increasing number of properties have shoreline lighting that illuminates the waterway.



From the human stand point; bright lights along the shoreline make it very difficult to navigate the channel. Glare from unshielded shoreline lighting prevents boater's eyes from becoming adapted to the darkness. At night, a boater will only be able to see the points of light along the shore rendering the channel markers and floating hazards very difficult to see. Clearly, glare along the shoreline results in a safety hazard that should be corrected.

Illuminated shorelines also impact fish and aquatic plants³⁰. Some fish are attracted to the light from their natural feeding depths. The increase in the concentration of small fish increases the hunting efficiency of predators. Although the behaviour of the nocturnal predator may not be compromised by artificial light, the ability of its prey to recognize the danger and to escape will affect their survival. This alters the ecological balance leading to unforeseen consequences.

3.7 Cultural Impact

There is a cultural imperative to protect the darkness of the night sky. Throughout recorded history (about 6,000 years) astronomy has been a focus of stories and

²⁶ Ecological Consequences of Artificial Night Lighting, C. Rich, T. Longcore, Island Press, 2006

²⁷ *ibid.*, Chapter 13

²⁸ Anecdotal reports from Parks Canada, 2011

²⁹ A. Barghini, B. de Medeiros, Artificial Lighting as a Vector Attractant and Cause of Disease Diffusion, doi: 10.128/ehp.1002115, August 2010, National Institute of Environmental Health Sciences, US Dept. of Health and Human Services

³⁰ Ecological Consequences of Artificial Night Lighting, C. Rich, T. Longcore, Island Press, 2006, Part V

mythologies. Those who have seen a dark sky are impressed by the serene majesty of the celestial sphere. It comes as no surprise that all civilizations have the constellations and asterisms woven into their culture.

After stepping outside from a lit room and under a dark rural sky, our initial count of a few stars with our photopic vision increases a hundred fold after only 10 minutes. This may increase by another order of magnitude after less than an hour as our eyes become fully dark-adapted. However, urban sky glow overwhelms the faint stars, and the glare from discrete light fixtures prevents our eyes from becoming dark-adapted. These limit the number of stars we can see from many thousands to only a few hundred. The consequence is that most people do not look up - because the view is only darkness. Our current generation is the first for whom much less than half the population has seen a star-filled night sky. Most children have never seen the Milky Way.

3.8 Spectrum of Artificial Light at Night

As discussed earlier and specified in Section 4 and summarized in Appendix L, only non-white light sources are permitted in Preserves. However conversion to compliant lighting can be relatively easy (see Appendix K).

Most lamps are based on incandescent, HPS, florescent and LED bulbs. Incandescent bulbs emit a broadband "warm" white light with a correlated colour temperature (CCT) of about 2700K. HPS lamps have a "spiky" amber spectrum. Although the colour "looks" yellow, it contains 10% blue light (<500 nm).

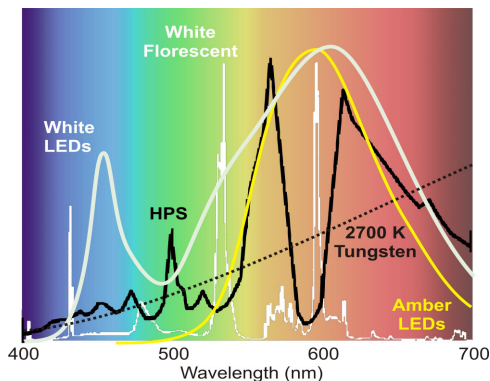


Figure 3.8 *Spectra of Common Lamps*

The light spectrum emitted by lamps depends on the physics of light emission. Incandescent lamps (~2700K tungsten filament) have a smooth spectrum that illuminates all coloured surfaces very well. All other sources only illuminate certain colours, which reduces the colour rendering. Although amber LEDs do not cover the range of colours as HPS lamps, it provides better colour rendering.

LEDs are available in a range of colours but they can be classified as white or amber. White-light LED luminaires are available with correlated colour temperatures (CCT) from 2700K to 5000K LEDs. However the amount of blue in these lamps can vary considerably between CCT and between companies from less than 10% to almost 40%. The amber LEDs (CCT ~1900K) emit virtually no blue light.

White light is not permitted in Preserves because of its impact on wildlife, vision and its high scattering properties in smoke and fog. Also, blue light affects the circadian rhythm of plants and animals - artificially altering their biology, and it provides subconscious lighting cues that may lead to inappropriate behaviours. For example some plants base their preparation for winter on the length of the night, which can be artificially shortened by artificial light, leading to a delay and reduced winter survival.

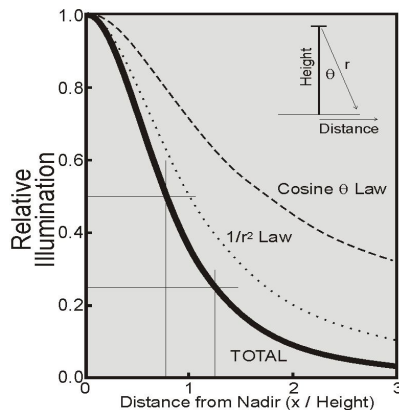
The blue spectral components attract insects to the light by approximately 50% over amber light. Apart from being a nuisance, insects can carry diseases that may be transmitted to park visitors.

The blue light components increase the impact of glare – up to 10X that of amber light. And when unshielded, white LEDs will undermine our night vision. With a compromised night vision, we are less able to see into dim areas - reducing safety by limiting our awareness of the surroundings (creating hazards) and affecting our ability to navigate at night. This lack of visibility also reduces our sense of safety and security.

3.9 Luminaire Shields

Unshielded lights are visible for “as far as the eye can see”. Shielding luminaires is critical for cutting widespread glare. Shielding improves visibility and the light's impact on the environment beyond the target area.

Unshielded lights will illuminate a very large area, however the illumination level more than 2 mounting heights from nadir is, quite literally, negligible - $<1/10$ that at nadir and contributes little to good visibility. The useful spread of the light is only about 1.5 X



mounting height from nadir. (This is due to the cosine law and the $1/r^2$ law, which are shown the accompanying figure.) So any light that shines beyond this distance primarily produces glare and wastes energy.

The light that shines within 10° below the horizon can undermine our night vision more than 100 meters away and can affect the aesthetic appearance of the night for more than a kilometre. Full cut-off fixtures (or Full-Shielded fixtures) limit the amount of light in this glare zone to $<10\%$ while Sharp Cut-Off fixtures limit it to $<1\%$. (See Appendix G).

To expand the target area with more useful light requires appropriately designed optics to "throw light" from nadir into the periphery. However they still limit the light in this glare zone to $<10\%$. These may be found in the more-expense luminaires.

Because of the spectral effects discussed in section 3.8, white light lamps require at least Sharp cut-off shielding for them to equal the effective of glare by amber light. Existing commercial luminaires (circa 2016) approach FCO but extra shields are required to convert them into Sharp cut-off.

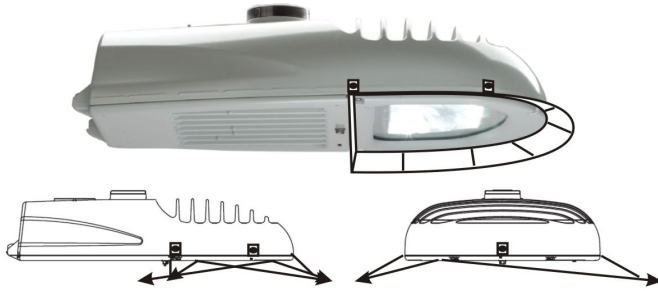


Figure 3.9 *Sketch of luminaire shield. This is a sketch of what a shield could look like. The shape is based on earlier shields that were used on non cut-off cobra lights. The front and back surfaces should be designed to limit light trespass. Similar concepts should be used for other types of luminaires.*

Mirror surfaces or bright coatings are effective at redirecting the light in the glare zone down into the target area resulting in a more effective light fixture. The removal of the offending glare significantly increases visibility across the illuminated area, and even beyond by helping to preserve our night vision. This increases our “sense of place” and “situation awareness”, and thereby increasing our safety and security.

3.10 Scheduling of Light

The timing of when the illumination is used is also important. Humans are the only creatures that want light at night, so it must only be used if there is human activity in the area. However, most public parks use lights that were selected before our understanding of the impact of ALAN on the ecosystem and many of these remain turned on because there are no switches or timing circuits.

Some Preserves define a Dark Time when outdoor lighting is discouraged. It typically begins 2-hours after sunset. This is supported by the behavioural plasticity of wildlife to the changing illumination due to cloud cover and variations in nightfall over the seasons.

There are four uses for outdoor lighting.

- Navigation - assists in wayfinding
- Safety - renders hazards more visible
- Security - assists personnel to protect persons and property
- Aesthetics - illuminates a cultural display

The role of artificial light at night is to only identify hazards and wayfinding during pedestrian activities, which require relatively low illumination levels.

The norms of urban areas do not apply in a Preserve. There are usually no security personnel that make regular security sweeps of campgrounds or other areas throughout the night. Therefore, the "best practice" for urban areas should not be used in Preserves. In Preserves, the aesthetic is the natural night, which is compromised by artificial light.

3.11 Summary

Artificial lighting that is installed for human activity is altering the natural environment. Currently, this environmental degradation supported by human night culture. The cause is primarily ignorance.

It is clearly shown in published research, that artificial outdoor lighting affects the ecology by disrupting food webs, animal biology and behaviours. Although the actual mechanism for this disruption is not always clear, this does not weaken the evidence for the damaging impact of artificial light on the ecosystem and the need to minimize it.

There is growing evidence for the degradation of human health with the illumination of the night – particularly the blue components in white light and may be causing an increase in chronic diseases.

Education is the key to reducing this degradation by ALAN. Establishing Preserves is an obvious way to help inform the public about the virtues of a dark night. And, by drawing their attention to the vitality of night animals in the Preserves they will begin to understand the importance of reducing artificial light at night in their home cities.

Wildlife has no voice and cannot control their environment. We must act on their behalf. Cities must take action and advocate against change in their environment.

4.0 GUIDELINES FOR OUTDOOR LIGHTING

The need for the reduction of light pollution has been explained in Chapter 3. The information and tables in this section present the quantitative limits to outdoor lighting in Preserves. Since the goals of the RASC Preserve Program are to promote and protect the night environment and promote astronomy, These Guidelines for Outdoor Lighting (GOL) apply to all Preserves. They give priority to the ecology, not urban lighting “best practice”.

The only difference between the RASC Dark-Sky Preserves and Urban Star Parks is the sky glow from external lighting over the site. It is understood that the establishment of an USP may not be sufficient to completely change the lighting politics of the urban area. Both DSPs and USPs should provide public outreach programs to explain and promote low-impact lighting and astronomy.

Nocturnal Preserves acknowledge that these outreach programs may not be practical due to limited staff and resources.

Before determining what type of lighting should be installed or retrofitted, it is important to ask the basic question; "Is the light necessary?" If there is no current need for artificial lighting, it should be removed rather than replaced - even with better technology. We should not assume there is a valid reason for a currently installed light.

This chapter provides guidelines that should be followed to minimize light pollution within a Preserve. It is recommended that the Preserve adopt similar equipment with low ecological impact to minimize the cost and complexity of inventory for repairs, replacements and re-purposing. Contact the RASC for assistance in selecting new compliant light fixtures, or modifying existing non-compliant luminaires.

Where necessary for basic safety and navigation:

1. Illumination should not exceed the specified levels
2. The affected area of illumination should be as small as practical,
3. The duration of the illumination should be as short as practical, and
4. Light fixtures should emit a minimum of blue spectral components (i.e. white light is not permitted).

What is “practical” depends upon the specific facilities in the area and the technology available at the time.

Illumination levels specified in this document are lower than urban areas for which most luminaires have been designed. This restricts the type of light sources that may be used. Although High Intensity Discharge (HID) and CFL lamps are very efficient, they may emit more light than is recommended in these guidelines. To address this, incandescent lights may be used for short periods of time or more advanced yellow or amber light emitting diodes (LEDs) may be installed.

These guidelines address the different types of facility and a range in pedestrian and vehicle traffic. However, the priority is given to respecting and protecting the natural environment.

Managers have the discretion to assess what levels are most appropriate for each built facility within the limits outlined in this chapter. Lighting is limited to provide only what is required for visitor navigation in built up areas. The artificial lighting is restricted to these areas and for the periods of human activity unless otherwise noted.

“Dark Time” is a term used in some parks to identify the end of significant activity within an area. This term is used herein to identify when the use of light should be discouraged. In this document, Dark Time is further defined as initiating 2-hours after sunset. Appendix D contains a reference table with the approximate times of sunset for parks in southern Canada (+50° latitude). Managers may define Dark Time that is suitable for their facility.

The following tenets have been used in developing these guidelines.

1. Buildings require illumination only when open or available to the public. After the office is closed to the public, all lighting visible from the outside should be turned off.
2. To save energy and minimize the duration and extent of light pollution, lit pathways should be illuminated only when pedestrians are in transit. All reasonable effort should be made to turn off lighting when pedestrian traffic is low or is no longer expected.
3. To minimize the impact of artificial lighting on the ecosystem, the areas covered by this guidelines should provide only enough light needed for a safe transition between lit structures and the surrounding unlit area, and to assist in navigation.
4. To minimize the ecological impact of light pollution, the extent of illumination should be strictly limited to only the area of current human activity.
5. To limit the duration of light exposure on the ecosystem and to save energy, light activated timing circuits should turn off outdoor lighting on or before the beginning of Dark Time or to the end of scheduled activity.
6. Where vehicle and pedestrian traffic is at a low speed or infrequent, retro-reflective signage should be used instead of installed lighting fixtures.

The IESNA BUG Designation System (Back-light, Up-light and Glare) that defines luminaire shielding is in Table 4.0. BUG lighting zone definitions are in Appendix F.

Table 4.0 BUG System Designation for Preserve Compliant Luminaires

| | | | | | |
|-------------------|----------------------|-------------------|-------------|---------------|----|
| BVH | <1% | FVH | <2% | UH, UL | 0% |
| BH, BM, BL | <10%, or as required | FH, FM, FL | As required | | |

In addition to these guidelines, compliant luminaires described using the "abbreviated" BUG designation should be B=0, U=0 and G=0.

This chapter identifies six types of structures that may require illumination within a Preserve. In all cases, full cut-off (FCO) or sharp cut-off (ShCO) luminaires should be used to prevent light scattering beyond the immediate area of the light fixture. Further, the colour of this light should be amber with minimal blue (short wavelength) content. This can be achieved with amber LED luminaires, amber "bug light" lamps or with amber filters (Roscolux Deep Straw #15). Lighting curfews should apply (See Section 3.10).

4.1 Buildings

Illumination levels and luminaire types for various buildings are listed in Table 4.1. Building signage is discussed in Section 4.8.

This guideline identifies five building classifications.

4.1.1 Administration Buildings

Administration buildings are defined as those with private offices and will generally be closed after dark. Illumination of the main doorway and especially any steps leading to the main door may be required after sunset in the late autumn, winter and early spring.

After hours, either all interior lighting should be turned off, or window and door blinds should be used to prevent interior light from shining outside. Light activated (sunset) or timing circuits should turn off all outdoor lighting within 30 minutes of the office being closed. Manual reset switches or motion detectors may be used to extend this period for late-working staff by a pre-programmed duration of typically less than 1-hour.

4.1.2 Public Buildings

Public buildings are defined as those open to the public during business hours and may also contain private offices. Due to the public nature of these buildings with potentially high pedestrian traffic, exterior illumination may be higher than for park administration buildings. Egress illumination should cover stairs, stoop and transition to uneven or dirt path.

After hours, either all interior lighting should be turned off, or window and door blinds should be used to prevent interior light from shining outside. All outdoor lighting should be turned off within 30 minutes of the building being closed. Exterior lighting should be limited to the main door area and steps. Light activated (sunset) or timing circuits should turn the lighting on after sunset and off after a period of time specified by the Manager and subject to the building use.

4.1.3 Retail Outlets

It is assumed retail stores will have higher pedestrian traffic than most other areas and illumination may be required while they remain open for business after dark.

Window coverings should be used so that interior lighting will not shine outside 30 minutes after sunset. Exterior light is permitted, and restricted to, FCO or ShCO fixtures illuminating the ground around the door. Exterior lighting should be turned off within 30 min. after business hours.

4.1.4 Vending Machines

Vending machines should be located in an enclosed space and their lights should not shine directly outside through doorways or windows. Where practical, these machines should be enclosed in existing public buildings. Figure 4.1.4 shows an example of a dedicated vending machine enclosure. Only FCO or ShCO fixtures should be used to illuminate the area outside the entrances. The extent of this outside illuminated ground area is restricted to less than 5 metres from the entrance.

Lamps for vending machines are fluorescent tubes behind the translucent display and may emit significant amounts of white and blue light. This light undermines our night vision. Unless dimmed or filtered, the illumination levels outside these enclosures may be higher than for other buildings to allow the transition for visitors from the bright interior to the dark surroundings.

Doorway lighting should be turned off or dimmed within two hours of sunset. Interior lighting may remain on at the owner's discretion.

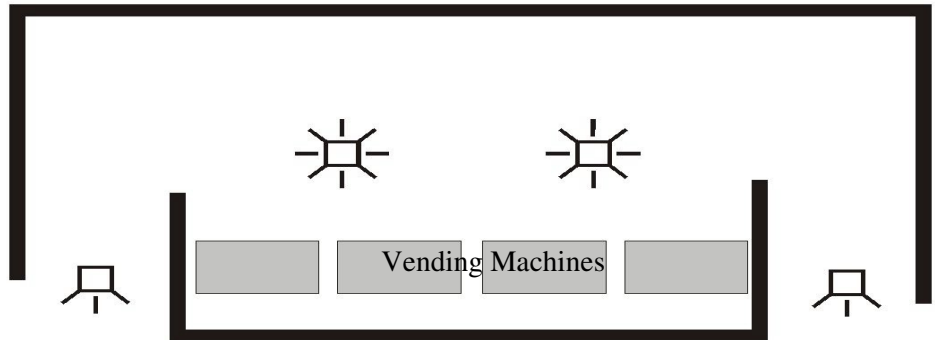


Figure 4.1.4 – Sample Vending Machine Enclosure

| Table 4.1 Building Illumination Guidelines (Maximum Values) | | | | | |
|--|-----------------|---|---------------|--------|--------|
| 4.1 Area | Type | Light* | Level (lux)** | Height | Curfew |
| 4.1.1 Admin. Bldgs. | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~2 lux | 2.5 m | Yes |
| 4.1.2 Public Bldgs. | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~2 lux | 2.5 m | Yes |
| 4.1.3 Retail Stores | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~2 lux | 2.5 m | Yes |
| 4.1.4 Vending Machine | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~2 lux | 2.5 m | Yes |
| 4.1.5 Toilet, Washroom, Shower Facilities | Marker (FCO) | Amber Incandescent, CFL or LED, Filtered | ~2 lux | 2 m | No |

* Wattages for individual lamp types are not specified due to differences in efficacy.

** 2 lux = illumination by clear sky about 20 minutes after sunset

Managers should consult Appendix C and J for guidance in meeting the recommended illumination level in all tables in Section 4.

4.1.5 Toilet, Washroom and Shower Facilities

If toilet, washroom and shower facilities are available throughout the night, FCO or ShCO fixtures should be used to illuminate the entrance and any steps leading to the doorway. The illuminated door may be used as the "marker light".

Interior lighting in these facilities must also be considered. Excessive interior lighting levels can produce serious glare through the windows that impairs exterior visibility. After sunset, interior lighting should use amber (bug lights) or red lamps, or amber filters whenever possible and lighting levels, measured horizontally at the floor, should not exceed 10 lux.

4.2 Parking Lots

Generally, parking lots have less traffic at night than during the day. Parking lots may require lighting due to scheduled after-dusk activities. This lighting may be necessary until gate closure or Dark Time, which ever occurs first.

Where required, pole mounted FCO or ShCO luminaires should be placed one pole-height from the extreme corners of the parking lot and distributed evenly along the perimeter with an approximate pole spacing of no less than 4-times the luminaire height. Their light distribution pattern should be "full forward" and aimed into the lot. This is symbolically shown in Figure 4.2. If necessary for larger parking lots, poles may be located within the parking lot area.

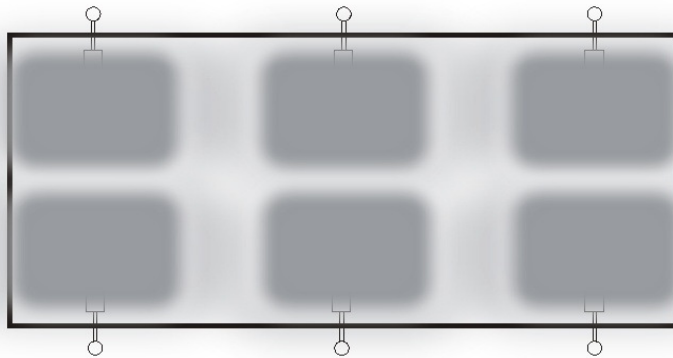


Figure 4.2 Parking Lot Lighting

4.2.1 Administration Parking Lots

Administrative personnel will generally leave when offices close. These luminaires should be turned off within 30 minutes of the office closure. A timing circuit should control the lights with a manual reset for late-working employees.

4.2.2 Visitor Parking Lots (Small)

Generally small lots (less than 10 cars) experience little traffic and should not be illuminated.

4.2.3 Visitor Parking Lots (Large)

Larger parking lots (spaces for approximately more than 10 cars) may require better visibility than smaller lots due to higher pedestrian and vehicle traffic densities. These lots may be illuminated at the discretion of the Manager. However illumination levels should not exceed the limits listed in Table 4.2.

| Table 4.2 Parking Lot Illumination Guidelines (Maximum Values) | | | | | |
|---|-------------|---|-------------|--------|--------|
| 4.2 Parking Area | Type | Light | Level (lux) | Height | Curfew |
| 4.2.1 Administration Lot | FCO ShCO | LPS, HPS or Amber CFL or LED, Filtered | ~3 | 6 m | Yes |
| 4.2.2 Visitor Lot < 10 cars | N/A | None | N/A | N/A | N/A |
| 4.2.3 Visitor Lot > 10 cars | FCO ShCO | LPS, HPS or Amber CFL or LED, Filtered | ~3 | 6 m | Yes |

N/A – not applicable

4.3 Roadways

Intersections are some of the most dangerous areas for drivers and pedestrians. Drivers of high-speed vehicles require sufficient time to react when they approach an intersection (approximately 3 second reaction time before brakes are applied). Therefore, major intersections should be marked with luminaires, signage or both. Illumination of adjacent areas should be minimized to avoid distracting drivers and to limit ecological impact.

Where federal or provincial roadways run through Preserves, lighting of these roadways should be evaluated. If lighting will affect the quality of the Preserve, then the Manager should request the government to use light fixtures that will most closely comply with these guidelines. Federal and provincial standards for roadway lighting refer to illumination levels, so FCO and ShCO shielding can and should be used. As a minimum, the Manager should form an agreement with the government so that they are asked to advise on the type of luminaires that are selected.

4.3.1 Class 1 to Class 3

Class 1 to Class 3 roadways are subject to high traffic volumes (Class 1) to medium traffic volumes (Class 3). Due to the high speed and volume of traffic, marker lighting may be required to alert drivers well in advance of the intersection.

To ensure they are visible to approaching traffic, these marker lights may be semi cut-off (SCO) luminaires with a Type II distribution pattern (illumination along the major road). They should be oriented to minimize illumination beyond the side of the road. External shields may be used to prevent light from shining out of the right-of-way.

To further minimize the impact of these luminaires, the luminaire should be mounted no higher than six metres and the power should be no greater than a 35 watt High Pressure Sodium (HPS) or amber LED to minimize the blue-light exposure to the environment.

Retro-reflective signage should be used for all other intersections between the Class 1 to 3 roadways and lesser roadways. Illuminated signage should not be permitted (see Section 4.8).

Where federal and provincial highway standards take precedence, the minimum-allowable illumination in the standard should be used.

4.3.2 Class 4 to Class 6

Class 4 to Class 6 roadways have low traffic volumes with class 6 roads seeing occasional and local traffic. They provide access to large areas of the Preserve. These roads see infrequent use of after hours. These roads and intersections should use retro reflective signs instead of lighting to minimize the ecological impact.

| Table 4.3 Roadway Illumination Guidelines (Maximum Values) | | | | | |
|--|--------------|--|-------------|--------|--------|
| 4.3 Roadways | Type | Light | Level (lux) | Height | Curfew |
| 4.3.1 Class 1-3 roadways | None | N/A | N/A | N/A | N/A |
| 4.3.2 Class 1-3 roads & intersections | SCO Marker | LPS, HPS or Amber CFL or LED, Filtered | ~3 | 6 m | No |
| 4.3.3 Class 4-6 Roads & intersections | Signage only | N/A | N/A | N/A | N/A |

N/A – not applicable

4.4 Pathways

Pathways and sidewalks provide a relatively level surface for pedestrian traffic, and aid in site navigation. Visibility is necessary for navigation but excessive illumination will prevent pedestrians from seeing off the path for situation awareness. Although visitors might use flashlights, additional pathway lighting may be required to guide visitors to public events and facilities.

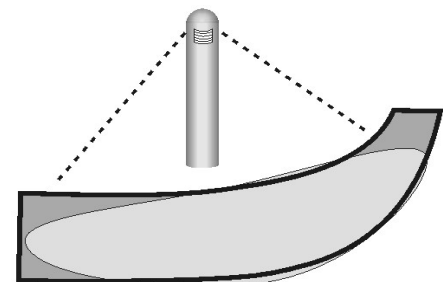
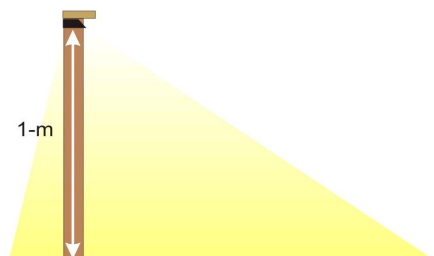
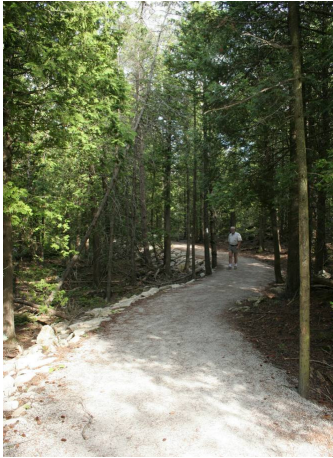


Figure 4.4.1 Bollard Luminaire

Paths are also used by wildlife. Therefore, pathway lighting should be restricted to only those paths near buildings, parking lots and campgrounds. Only those paths the Manager considers appropriate should be illuminated.



Since overhead FCO and ShCO luminaires will illuminate areas much wider than the path, low wattage bollard lighting, or railing mounted lighting, should be used such that the light is directed down and along the path. Fixtures should be shielded or lensed such that the illumination is approximately limited to the path width.



Pathways should use white or light coloured crushed stone (limestone) instead of asphalt to help reflect ambient light.

Generally, individuals walking along a pathway will have left the area after a minute or so (a distance of 30 metres) unless they remain for an activity. To minimize unnecessary light exposure, motion detectors should be used to turn on the string of lights and timing circuits to turn them off after a few minutes. Detectors may be installed at the entrances to pathways or at the limits to the illumination portion of the path.

Passive fluorescent markers may be used to mark the extent and direction of the pathway when the lights are off. These may be mounted on bollards or in the pathway surface.

The closeness of the luminaires to the ground necessitates very low intensity lights. This limits the current available products to low wattage incandescent bulbs and amber, or filtered LEDs. Low-brightness CFL Lamps are not yet available.

1. Whenever possible, pathways in the PRESERVE should not be illuminated. If deemed necessary by the Manager, specific pathways may be illuminated, or lined with white or yellow paint, or have fluorescent markers.
2. Illuminated pathways should have FCO or ShCO shielded fixtures, mounted on low-height poles, railings or bollards.
3. Pathway lighting should be turned off during the Dark Time lighting curfew. Retro-reflective markers or florescent markers on the bollards/railing may be used to assist pedestrians after Dark Time.
4. Main pathways leading to all-night facilities may be illuminated throughout the night at the discretion of the Manager but limited to Table 4.4.

| Table 4.4 Pathway Illumination Guidelines (Maximum Values) | | | | | |
|---|-------------|---|-------------|--------|--------|
| 4.4 Pathways | Type | Light | Level (lux) | Height | Curfew |
| 4.4.1 Pathways | None | None | N/A | N/A | N/A |
| 4.4.2 Illuminated Paths | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~1 lux | 1 m | Yes |
| 4.4.3 Main Pathways | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~1 lux | 1 m | No |

N/A – not applicable

4.5 Shorelines

This section provides guidance to Managers for reducing the impact of lighting along a waterway. Shorelines consist of docks, jetties, lock facilities, boat launching areas, beaches, homes, cottages and undeveloped lands. Direct illumination of the shallow water

near shore alters the behaviour of aquatic species and the foraging patterns of land species and insects.

These guidelines are relatively general due to the limited authority of Managers over some of these properties.

1. Park personnel should inform the owners and users of shoreline property of the impact artificial light has on the ecology of the water and adjacent lands.
2. Property owners should be advised to shield all outdoor lighting to comply with FCO or ShCO requirements and to turn off this lighting when they go to bed.
3. Shoreline lighting should consist of amber or red light. Blue and white lights are not permitted.
4. Light fixtures should be prohibited within ten metres of a shoreline unless the Manager deems them necessary. Overhead luminaires that shine into the water are not permitted.
5. High traffic areas and areas near machinery (lock facilities) may require higher levels of illumination at the discretion of the Manager.

| Table 4.5 Shoreline Illumination Guidelines (Maximum Values) | | | | | |
|---|-------------|---|-------------|--------|--------|
| 4.5 Waterways | Type | Light | Level (lux) | Height | Curfew |
| 4.5.1 General Areas | N/A | None | N/A | N/A | N/A |
| 4.5.2 Dock Bollards | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~1 lux | 1m | No |
| 4.5.3 Lock Facilities | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~3 lux | 6 m | Yes |

* - lowest practical wattage

N/A – not applicable

4.6 Colour or Spectrum of Illumination

All outdoor illumination shall be amber. Illumination described as "warm", "warm white", or Dark Sky Friendly are not necessarily compliant. On a case-by-case basis the RASC may allow 3000K LEDs. However, no more than 1% of the total emitted light shall be emitted in the "glare zone" between 90-80 degrees from nadir (ShCO requirements). And, the illumination level must be less than 1/4 the levels specified in this chapter. This will help preserve night vision and limit the extent of the ecological impact.

4.7 Scheduling Illumination

Wayfinding requires very little light (0.1-1 lux), but unshielded fixtures undermine this because the glare prevents the visibility of trees and other landmarks. Some Preserves have a defined a Dark Time during which all unnecessary lighting should be turned off.

Dark Time typically begins 2-hours after sunset. The Manager may identify safety-critical lighting that should remain on but in a significantly dimmed level.

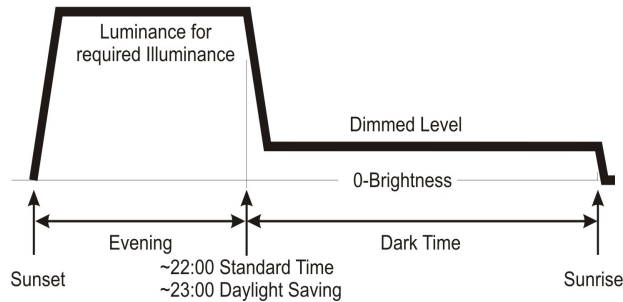


Figure 3.10 Illumination Schedule.
Light may be used during peak activity during twilight and early evening. At the beginning of dark time the outdoor artificial light should be turned off or significantly dimmed.

Virtually all visitors to a park use flashlights. So visitors have light when necessary during Dark Time. Convenient signage compliments the use of these personal lights (See Section 4.8).

4.8 Signage

Signs within a Preserve are essential to the efficient navigation of the site. They may display three forms of information: names for sites or buildings (usually mounted in proximity to buildings or other structures), directions (located along roadways or pathways and their intersections) and those meant to convey other information (also located to the side of roadways and pathways).

Illuminated signs shall be prohibited in a Preserve. These include, but are not limited to, back illuminated signs, electronic billboards, signs illuminated from below and above the sign, and in front of the sign. To provide the visibility of signs after dark, their location, colour scheme, and material should permit reading the sign with flashlights or existing compliant pathway or roadway lighting.

When deemed necessary by the Manager, signs may be illuminated to the levels in Table 4.6.

| Table 4.6 Signage Illumination Guidelines (Maximum Values) | | | | | |
|---|----------------------------------|----------------------|-------------|--------|--------|
| 4.6 Signage | Type | Light | Level (lux) | Height | Curfew |
| 4.6.1 Building | Reflective, Light colour | Amber LED*, Filtered | ~3 lux | 1-2 m | Yes |
| 4.6.2 Navigation | Reflective, Light colour | Amber LED*, Filtered | ~3 lux | <1 m | N/A |
| 4.6.3 Information | Retro-reflective Light colour | Amber LED*, Filtered | ~3 lux | 1-2 m | Yes |

* Lowest wattage for about 3 lumen/ m² (0.3 lumen/ft²) N/A – not applicable

Retro-reflective signage should be used to ensure signs are visible only when necessary. Signs may be mounted on or near buildings such that exterior building lighting may provide some illumination, and they should use colours consistent with retro-reflective materials and illumination with flashlights.

Pathway and information signs should be located less than one metre above the grade of the path so they may be found and read by pedestrians with flashlights after dark. All

bollards and railings should be marked with retro-reflective material so they may be visible to pedestrians after Dark Time. Roadway signs should be mounted in accordance with standard roadway practice.

4.9 Tower Navigation Avoidance Beacons

There is a proliferation of communication towers for cell phones and for wind turbine power generation. Towers that may have heights of hundreds of metres are being erected in otherwise unspoiled areas. Managers should be aware of the options available for tower navigation beacons that are regulated by Transport Canada³¹ and Industry Canada. Communication towers erected on or near Preserve should not be fitted with night navigation beacons unless strictly required by Transport Canada regulations (CARS 621.19). The brightness of night navigation beacons should be the minimum required by Transport Canada regulations (CARS 621.19). And, all towers requiring night navigation beacons should use red flashing lights.

There are several types of navigation avoidance beacons that may be used on towers (see Appendix E). A low impact example is a beacon with a collimated rotating beam (Appendix E CL864). In principal, its luminous intensity can be lower than other types of beacons and would emit less total light into the air, resulting in less scattered light into the environment but maintains its critical visibility to pilots. Birds are not attracted to red light as much as white light and they appear to be less able to orient themselves to the flashing beacons compared to non-flashing types³².

Tower and wind turbine lighting may not be required unless the tower exceeds 90 meters. Consult applicable national aviation standards for the specific location. Single wind turbine towers less than 90 metres high do not have to be lighted unless specifically identified by Transport Canada as a hazard to aviation. For wind farms with several towers, the towers on the edge of the array and the central tower must be illuminated³³.

Managers may not have authority over the illumination of these towers so these guidelines are provided as a guide when discussing tower illumination with tower owners and Transport Canada. Where tower lighting contributes undue glare or illumination within the Preserve, Transport Canada may consider collimated beacons or down-shields.

4.10 “Developed” Properties

These properties include, but are limited to, private-owned and rental properties and towns within the Preserve's boundaries.

Owners of private properties within the Preserve should be informed of the impact of artificial lighting on wildlife. They should be encouraged to remove “dusk to dawn” lights, replace “yard lights” with FCO or ShCO luminaires. And they should replace

³¹ Canadian Aviation Regulations (CARS) 621.19

³² Gehring, J. Aviation Collision Study for the Michigan Public Safety Communications System (MPSCS): Summary of Spring 2005 Field Season, Central Michigan University, August 12, 2005

³³ Wind Turbine and Windfarm Lighting, CAR621.19 Advisory Circular 1/06 - DRAFT 9, Transport Canada

white LED, MH bulbs with either HPS, Low Pressure Sodium (LPS) fixtures or amber LED or filtered fixtures. They should be encouraged to turn off all exterior lighting when they are indoors.

All municipal lighting should be FCO or ShCO and illumination levels should be no greater than the "minimum" recommended IESNA Guidelines (RP-08). White light luminaires are not permitted, however 3000K LED luminaires may be approved by the RASC if they comply with Section 4.6.

The outdoor lighting on built facilities under the control of the Manager should use FCO or ShCO fixtures. Area lighting fixtures, such as "yard lights" and "dusk to dawn" fixtures or similar luminaires, are not permitted. White LED, Metal Halide (MH) or mercury vapour lamps are not permitted. These products produce excessive glare and light trespass and emit short wavelength light that affects wildlife and our night vision.

Use of outdoor lighting on all built facilities within Preserve should be discouraged during the Dark Time, and should be turned off when people are indoors. The RASC may approve some lighting on a case-by-case basis but this must be specifically requested in the Preserve application.

| Table 4.8 Other Properties Illumination Guidelines Maximum Values) | | | | | |
|---|------|--|-----------------|--------|--------|
| 4.8 Other Properties | Type | Light* | Level (lux) | Height | Curfew |
| 4.8.1 Door Lights | FCO | Amber Incandescent, CFL or LED, Filtered | <3 | 1.5 m | Yes |
| 4.8.2 Yard Lights | FCO | LPS, HPS, Amber CFL or LED, Filtered | <3 | 6 m | Yes |
| 4.8.3 Municipal Lights | FCO | LPS, HPS, Amber CFL or LED, Filtered | ≤ minimum IESNA | TBD | No |

* Wattage of lamps should be based on illumination limits.

4.11 Light Pollution Abatement Beyond Preserve Boundaries

As with air and water pollution, light pollution respects no boundaries. Light pollution is best reduced at the source by decreasing the light emitted. Some cities are actively promoting the replacement of luminaires that contribute to sky glow but these policies are not wide spread. Preserves may influence the producers of air and water pollution and this influence should be extended to include light pollution.

- Managers should introduce and encourage programs of light pollution abatement in neighbouring municipalities around the Preserve with the goal of reducing glare across the Preserve boundaries and sky glow visible from within the Preserve.
- Managers should approach individuals whose lights shine into the Preserve. The goal is to have those lights shielded, reduced in brightness or removed.

4.12 Historic Sites

These guidelines give priority to wildlife in the Preserve; but historic sites may be located within urban areas where light pollution is generally so bad that lighting to the above standards will have no significant improvement. The philosophy of not over-lighting the area is prudent for better visibility, which leads directly to safety, aesthetics, and it will reduce operating costs.

Outdoor lighting at historic sites should use FCO or ShCO fixtures and should illuminate the facilities to the minimum levels of standards and guidelines in the surrounding area. If “Period Lighting Fixtures” are used on the site, then the FCO or ShCO varieties should be used where possible. Historic lighting rarely included "white light, so amber light should be used because perceptually it is also more historically accurate.

4.13 Wilderness Areas

Wilderness areas are all “undeveloped” properties in their natural state. No artificial lights shall be installed in wilderness areas.

The use of personal red or amber flashlights should be encouraged but high power flashlights (> 300 lumens) should not be allowed. As with permanent lighting, amber and red light flashlights will reduce glare and help maintain dark adaptation. The use of white flashlights should be discouraged or used sparingly. Installation and extended use of portable outdoor lighting is strictly prohibited.

5.0 LIMITATIONS

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DRAFT 9, Transport Canada
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<http://advances.sciencemag.org/>

6.2 Web Sites

Astronomy Outreach and Education Materials
www.starlight-theatre.com

Canadian Aviation Regulations (CARS) 621.19
<https://www.tc.gc.ca/eng/civilaviation/regserv/cars/part6-standards-standard621-512.htm>

International Dark Sky Association
www.darksky.org

Fatal Light Awareness Program
www.flap.org

Light Pollution by Pierantonio Cinzano
www.lightpollution.it/indexen.html/

Royal Astronomical Society of Canada (RASC) Light Pollution Abatement Program
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The Urban Wildlands Group
www.urbanwildlands.org/abstracts.html

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APPENDIX A - Natural and Urban Illumination Levels

| Condition | Illumination Levels* (lux)** |
|---|---------------------------------|
| Clear night sky (no Moon) | 0.000 05 |
| Clear Urban Sky with Light Pollution | 0.015 |
| Twilight | 0.1 |
| Overcast Urban Sky with Light Pollution | 0.15 |
| Full Moon | 0.26 max. (0.1 typical) |
| Urban Road Artificial Illumination | 3-4*** |
| Open Urban Parking Lot | 11-22 |
| Car Dealership Lot | 200 |
| Full Sunlight | 130,000 |

* Clarity of the atmosphere is highly variable over hours and days. These values are presented to provide only a rough guide to approximate illumination levels.

** “lux” is a Système internationale (SI) unit of illumination equal to 1 candela/m² (cd/m²) = 0.093 foot-candles (fc)

*** IESNA RP-8-00

To place these levels in context, people have reported seeing “fine” at full Moon illumination levels in the absence of glare³⁴.

³⁴ Preliminary Recommendations: Outdoor Lighting at Highlands Center, Cape Cod National Seashore, Chad Moore, March 25, 2006

APPENDIX B - Colour of Various Light Sources

This table lists six lamps that convey “colour” from bright white to deep yellow and amber. LEDs can be designed to provide a range of different colours so they have two entries.

| | |
|--------------------------------------|--|
| White Light LEDs | Available in a range of CCT with 10% to >50% blue light. Blue light components impact the biology and behaviour of wildlife and plants. Undermines night vision. Should not be used in a PRESERVE due to ecological impact and vision degradation. White light gives very good colour recognition. |
| MH – Metal Halide | HID lamp that must be warmed up before it can reach full brightness. MH has high blue spectral content, produces a significant amount of UV and therefore its use should be avoided in all Preserves. |
| Incandescent bulbs | These emit a warm white light (~2700K CCT) and have very low energy efficiency. They can be turned off and on very quickly so they can be used for motion detection systems. Should be considered only if amber LED or amber CFL lamps are not available with low enough brightness. |
| HPS - High Pressure Sodium | These are bright yellow and allow fair colour recognition. A HPS bulb has a small light-emitting region for very good control over where the light is focused. As a HID source, they require a few minutes to heat up before they reach their design brightness. |
| Amber CF – Compact Fluorescent Lamps | These produce filtered light and are commercially sold as bug and party lights. They may be identified as yellow and orange but their colour and quality vary greatly. Choose darker yellow and orange whenever possible to avoid flying insect attraction. They typically do not perform as well in cold temperatures and may take several minutes to warm up in sub-zero temperatures. |
| LPS - Low Pressure Sodium | Deep yellow light is virtually a single colour offering very poor colour recognition. It is the most energy efficient of the above lamps. They are so efficient that even low wattages may produce too much light for use in Preserves. The light-emitting region in the lamp is quite large compared to other HID lamps. |
| Amber and Red Light Emitting Diodes | Amber and red LEDs have low impact on the environment. They can produce very focused illumination, which is very desirable for Preserve applications. For Preserve purposes “Amber” is defined as light in the wavelength of 500 – 700 nm and “Red” is 600 - 660nm. Most people can see "better" with amber than red LEDs. |

APPENDIX C - Light Output from Typical Bulbs

| Bulb Types | Lumens | Lux at 6 m | Lux at 2 m | Lux at 1 m |
|-----------------------------------|--------|------------|------------|------------|
| Incandescent* | | | | |
| 7 watt | 60 | 0.13 | 1.2 | 4.8 |
| 15 watt | 128 | 0.28 | 2.6 | 10.2 |
| 40 watt | 342 | 0.8 | 6.8 | 27.2 |
| 60 watt | 513 | 1.1 | 10.2 | 40.8 |
| 100 watt | 855 | 1.9 | 17.0 | 68.0 |
| Metal Halide (MH) | | | | |
| 70 watt | 3,000 | 6.6 | 59.7 | 238.7 |
| 100 watt | 5,800 | 12.8 | 115.4 | 461.6 |
| High Pressure Sodium (HPS) | | | | |
| 35 watts | 2025 | 4.5 | 40.3 | 161.1 |
| 50 watts | 3600 | 8.0 | 71.6 | 286.5 |
| 70 watts | 5450 | 12.1 | 108.4 | 433.7 |
| 100 watts | 8550 | 18.9 | 170.1 | 680.4 |
| Low Pressure Sodium (LPS) | | | | |
| 18 watts | 1570 | 3.5 | 31.2 | 124.9 |
| 35 watts | 4000 | 8.8 | 79.6 | 318.3 |
| 55 watts | 6655 | 14.7 | 132.4 | 529.6 |
| Compact Florescent (CF) | | | | |
| 9 watt (40 w equivalent) | 550 | 1.2 | 10.9 | 43.8 |
| 13 watt (60 w equivalent) | 850 | 1.9 | 17.9 | 71.6 |
| LED** | | | | |
| 1 watt (amber) *** | 75 | 2. | 19 | 75 |
| 3 watt amber A19 | 90 | 0.5 | 4.0 | 12 |
| 3 watt amber PAR16 | 90 | 1.8 | 16 | 50 |
| 7 watt amber PAR30 | 200 | 5.5 | 50 | 200 |
| 13 watt amber PAR38 | 400 | 11 | 100 | 400 |

Note:

Fixture and bulb degradation before cleaning or replacement may decrease these to as low as 50%.

Fire has an approximate efficacy of 0.5 lumens/watt

* The luminous efficiency of incandescent light is approximated as 1/10 that of HPS for photopic vision

** Supplied by IDA

*** Assumes a 1 steradian illumination angle and no external optics, typical for 2011

Lumens is the total amount of light emitted in all directions (over 4π steradians)

Lux is the amount of light illuminating a surface of one metre square

1 lux = 1 Lumen / ($4\pi \text{ dist}^2$) where distance is in metres

References:

IDA Information Sheet 4, Operating Data and Economics of Different Lamps, (08/96)

CAN/CSA-C653-94 (2000) - Performance Standard for Roadway Lighting Luminaires

Mesopic Street Lighting Demonstration, Lighting Research Centre, Jan. 31, 2008, (Rensseaeer), Table 2, 5

APPENDIX D - Approximate Times of Sunset (Areas in Southern Canada - +50° Lat.)

The time of sunset depends on the time of year and the latitude for a site. The following table lists the approximate time of sunset (DST) for latitude of about +50 degrees from May to the end of September.

| | |
|-------------|------|
| May 1 | 8:17 |
| 8 | 8:29 |
| 15 | 8:38 |
| 22 | 8:48 |
| 29 | 8:57 |
| June 1 | 9:00 |
| 8 | 9:08 |
| 15 | 9:11 |
| 22 | 9:13 |
| 29 | 9:13 |
| July 1 | 9:13 |
| 8 | 9:09 |
| 15 | 9:04 |
| 22 | 8:57 |
| 29 | 8:48 |
| August 1 | 8:42 |
| 8 | 8:31 |
| 15 | 8:19 |
| 22 | 8:06 |
| 29 | 7:50 |
| September 1 | 7:45 |
| 8 | 7:30 |
| 15 | 7:15 |
| 22 | 6:59 |
| 29 | 6:44 |

From the Royal Astronomical Society of Canada
Observers Handbook

APPENDIX E - Navigation Beacon Photometrics³⁵

| Light Type | Colour | Signal type | Minimum Intensity (candelas) (a) | | | Vert. beam spread (b) | Intensity (candelas) at given elevation angles when the light is levelled (c) | | | | |
|------------------|------------------|-------------------|----------------------------------|-------------|------------|-----------------------|---|-----------------|------------|----------|----------|
| | | | day | twilight | night | | - 10deg (d) | - 1deg (e) | ± 0deg (e) | + 2.5deg | +12.5deg |
| CL810 | red | fixed | N/A | 32min | 32min | 10deg | ----- | ----- | ----- | 32 min | 32 min |
| CL864 | red | flashing 20-40fpm | N/A | N/A | 2,000 ±25% | 3 deg min | ----- | 50% min 75% max | 100% min | ----- | ----- |
| <u>CL865 (f)</u> | <u>white (f)</u> | flashing 40fpm | 20,000 ±25% | 20,000 ±25% | 2,000 ±25% | 3 deg min | 3% max | 50% min 75% max | 100% min | ----- | ----- |
| CL866 | white | flashing 60fpm | 20,000 ±25% | 20,000 ±25% | 2,000 ±25% | 3 deg min | 3% max | 50% min 75% max | 100% min | ----- | ----- |
| CL885 Catenary | red | flashing 60fpm | N/A | N/A | 2,000 ±25% | 3 deg min | ----- | 50% min 75% max | 100% min | ----- | ----- |
| CL856 | white | flashing 40fpm | 270,000 ±25% | 20,000 ±25% | 2,000 ±25% | 3 deg min | 3% max | 50% min 75% max | 100% min | ----- | ----- |
| CL857 Catenary | white | flashing 60fpm | 140,000 ±25% | 20,000 ±25% | 2,000 ±25% | 3 deg min | 3% max | 50% min 75% max | 100% min | ----- | ----- |

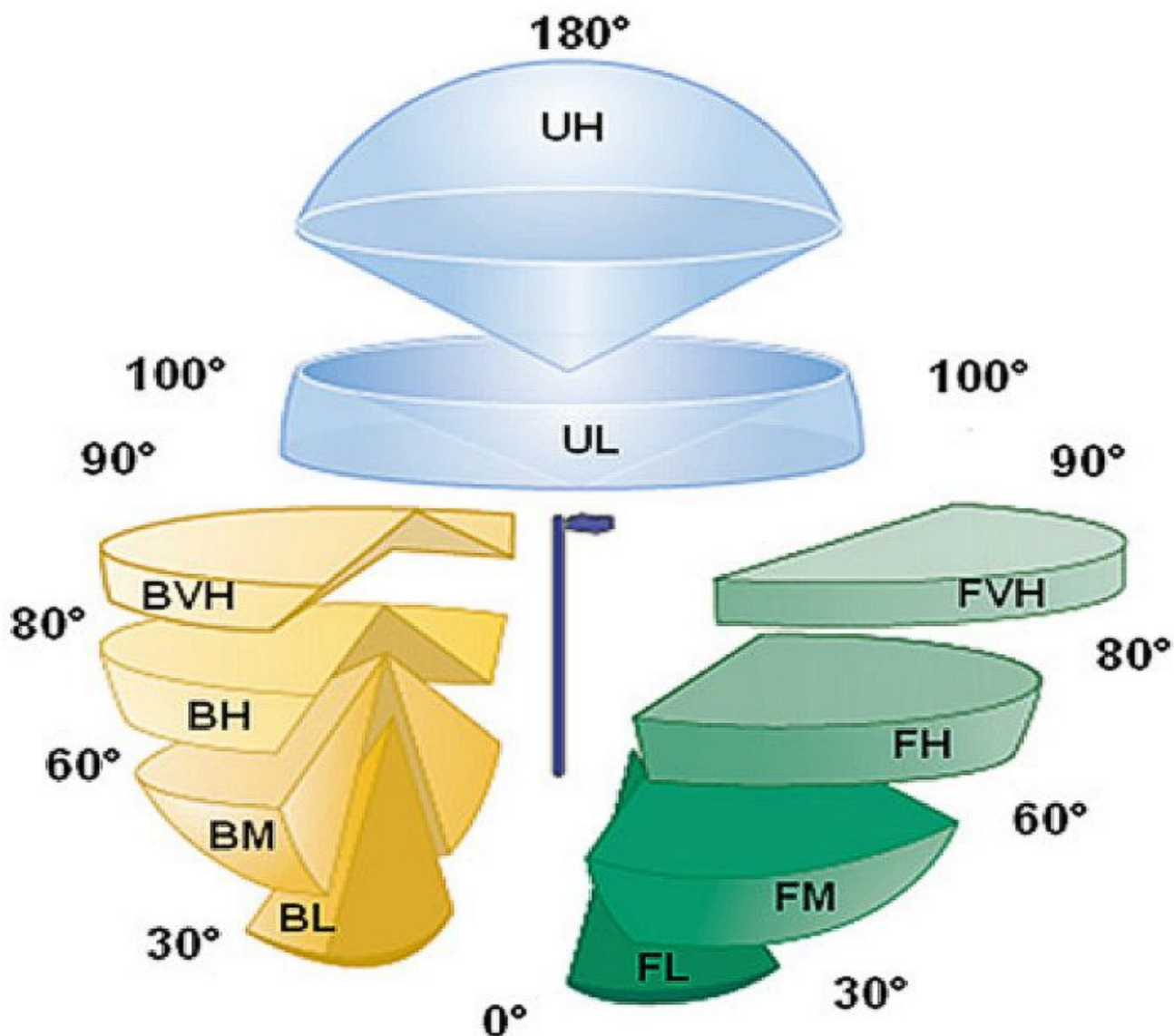
- (a) Effective intensity, as determined in accordance with External Transport Canada Document
- (b) Beam spread is defined as the angle between two directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the intensity shown in columns 4, 5 and 6. The beam pattern is not necessarily symmetrical about the elevation angle at which the peak intensity occurs.
- (c) Elevation (vertical) angles are referenced to the horizontal.
- (d) Intensity at any specified horizontal radial as a percentage of the actual peak intensity at the same radial when operated at each of the intensities shown in columns 4, 5 and 6.
- (e) Intensity at any specified horizontal radial as a percentage of the lower tolerance value of the intensity shown in columns 4, 5 and 6.
- (f) In the case of rotating type CL865 one third of the flash display should be red in colour. e.g. WWR

³⁵Wind Turbine and Windfarm Lighting, CAR621.19 Advisory Circular 1/06 - DRAFT 9, Transport Canada

APPENDIX F - IESNA BUG Designation System

The IESNA BUG System has been developed to more specifically define the illumination from a luminaire. Ten zones have been defined that affect the shielding and glare from a light fixture.

The Addendum A for IESNA TM-15-07 provides examples of this system for a given luminaire. The diagram below (IDA Specifier Bulletin for Dark Sky Applications, Vol. 2(1), 2009) visually defines the different zones.



FCO luminaire preclude any up light (UH and UL = 0% of total emitted light). To minimize glare and light trespass that increases the impact area of the illumination should have BVH and FVH as close to 0% as possible. FCO fixtures allow 10% of the total light to be emitted in the zone from 80° to 90° of nadir (Glare Zone). However the preferred Sharp Cut-off designation only permits 1% in the Glare Zone.

APPENDIX G - Summary of RASC Recommended Lighting

This summary applies to all property and structures within the Preserve.

1. No additional light fixtures should be installed.

If additional light fixtures are considered necessary by the Park Manager, and with approval by the RASC, additional fixtures may be installed. All new fixtures should conform to the requirements of Items 3-8 below.

2. Signage should not use active lighting.

Signage should use retro reflective materials. Pedestrian signs should be mounted at a height suitable for illumination with flashlights (<1 metre from the ground).

3. Only full cut-off (FCO) and Sharp cut-off (ShCO) fixtures should be used.

All existing light fixtures should be replaced with FCO or ShCO fixtures or shielded to prevent light from shining above the horizon or beyond the immediate area requiring illumination.

4. The illumination level produced by all light fixtures should be as low as practical.

Dusk and night pedestrian and vehicle traffic densities should be used in assessing the level of illumination within the limits of this Guideline. For vehicles, typically < 70-watt HPS at 6-m is sufficient (3 lux) for large parking lots and high traffic density areas where low speed limits are in effect. Major pedestrian routes may be illuminated by typically < 8-watt incandescent light or <1 watt amber LED (< 5 lux). With the use of vehicle headlights and pedestrian flashlights, lower power lamps can be used with the understanding that they are used only as marker lights. Phosphorescent markers may be used.

5. Structures and barriers should be used to confine illumination to the immediate area.

Illuminated areas should be bordered by trees and bushes, or other barriers, to prevent the light from shining and scattering beyond the area being illuminated.

6. All light sources should be turned off within 2-hours of sunset (Dark Time)

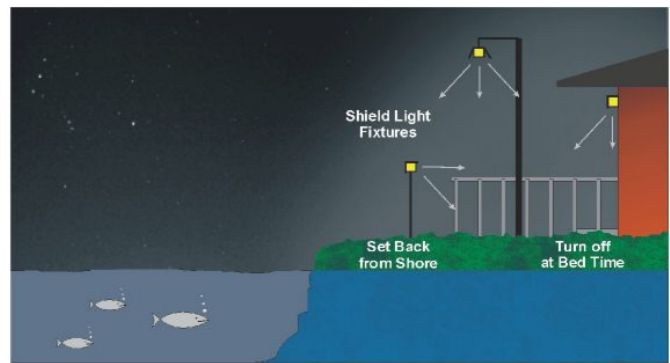
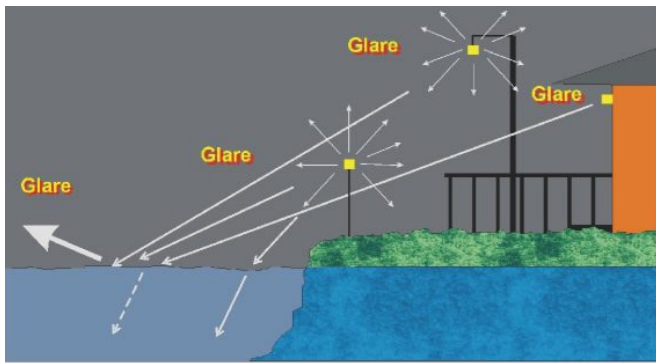
Automatic timers should be used to avoid the need for staff to turn off the lights. The timers should detect nightfall and should turn the lights off within 2-hours. If the Park Manager considers lights will occasionally be required after this time, the timer should be capable of being reset by staff.

7. Indoor lighting should be prevented from shining through exterior windows.

If interior lights must be used after sunset, window curtains should be closed within 30-minutes of sunset or interior illumination levels must be reduced significantly so as not to produce glare or light trespass.

8. The colour of all light fixtures should emit <1% blue light in their spectrum.

“White” light sources such as metal halide lamps and white LEDs should not be used. High-pressure, and low-pressure sodium lamps, incandescent and CFL bulbs, and amber LEDs may be used as long as they are in FCO fixtures and they provide amber light at the required illumination levels.



The Bad and the Good
Shoreline Lighting



White Stone on Pathway
and Shielded Bollard

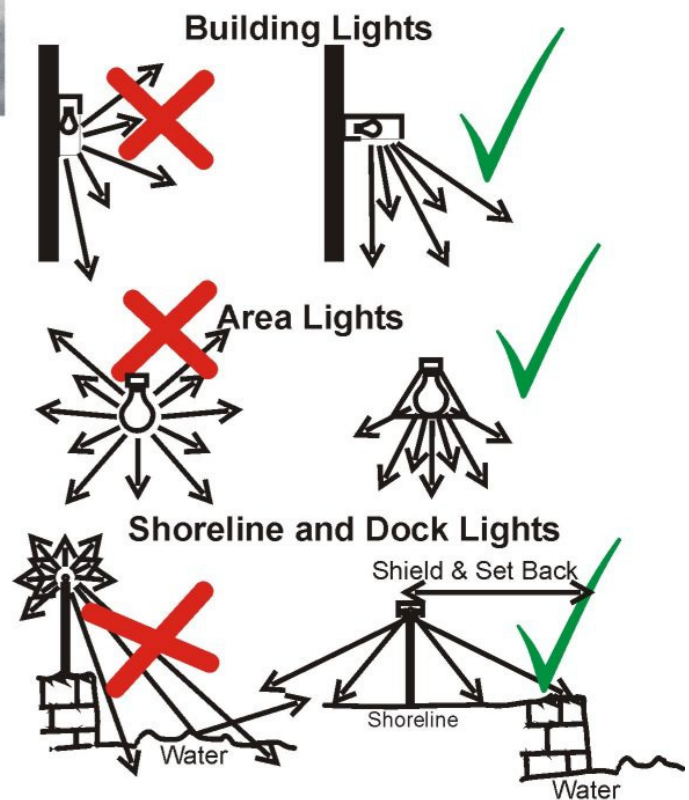
Use “Warm Light”
- not white light

Use Timers

- on at sunset
- off 2-hours later

Use Motion Sensors

- lights on only
when needed



APPENDIX H - Critical Outdoor Lighting Attributes

Colour and Spectrum

Only amber light should be used. No white light should be permitted. The energy spectrum of amber light (>500 nm) shall contain less than 2% of the total emitted light as shown in Figure G.1

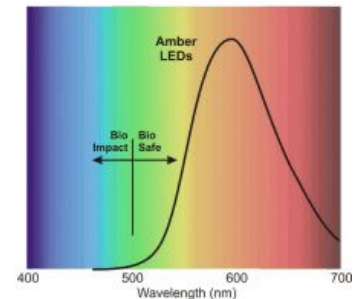


Figure G.1: *The spectrum of compliant amber light for Preserves.*

Shielding

All luminaires shall have Full Cut-Off or Sharp Cut-Off shielding or better. The industry definition of FCO shielding is for only 10% of the total light the luminaire shall be emitted within the zone between 80-degrees and 90-degrees from nadir. And, zero light shall be emitted above 90-degrees from nadir. ShCO shielding allows only 1% of the light in the glare zone. This is presented in figure G.2

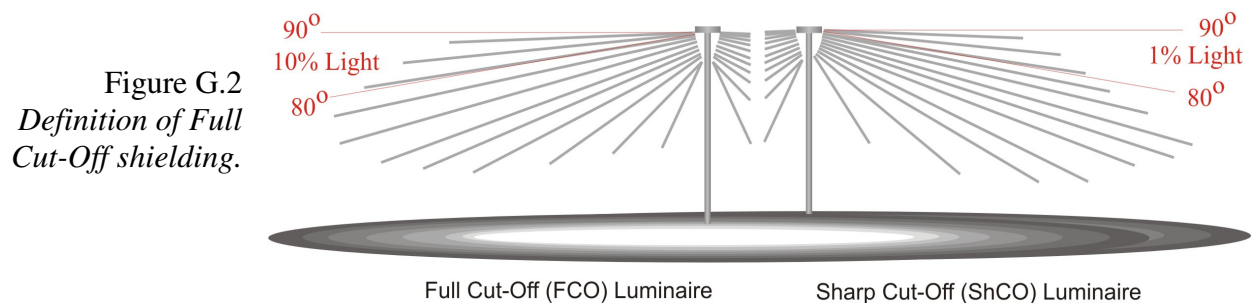


Figure G.2
Definition of Full Cut-Off shielding.

Brightness

The illumination levels (brightness) shall be limited to those tabulated in Chapter 4 and compiled in APPENDIX I. These lux values require selecting lamps with the correct wattage. We provide a guide to these wattages in the table of APPENDIX J.

It is obvious that these powers are considerably less than typical luminaires. There are two reasons for this.

- 1) The illumination in a Preserve is based on protecting the ecology, not maximizing visual impact.
- 2) By shielding to either FCO or ShCO and using non-white light, our night vision is preserved and the resulting visibility is quite good.

Tests performed with these levels provide very good visibility for visitors in a park setting.

APPENDIX I - Summary of GOL Illumination Tables

| Table 4.1 Building Illumination Guidelines (Maximum Values) | | | | | |
|--|-----------------|---|-------------|--------|--------|
| 4.1 Area | Type | Light* | Level (lux) | Height | Curfew |
| 4.1.1 Admin. Bldgs. | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~2 lux | 2.5 m | Yes |
| 4.1.2 Public Bldgs. | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~2 lux | 2.5 m | Yes |
| 4.1.3 Retail Stores | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~2 lux | 2.5 m | Yes |
| 4.1.4 Vending Machine | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~2 lux | 2.5 m | Yes |
| 4.1.5 Toilet, Washroom, Shower Facilities | Marker (FCO) | Amber Incandescent, CFL or LED, Filtered | ~2 lux | 2 m | No |

* Wattages for individual lamp types are not specified due to differences in efficacy.

Park Managers should consult Appendix C of the GOL for guidance in meeting the recommended illumination level in all tables in Section 4.

Note: 1 lux = limit for reading printed text in brochure

2 lux = illumination by clear sky about 20 minutes after sunset

| Table 4.2 Parking Lot Illumination Guidelines (Maximum Values) | | | | | |
|---|-------------|---|-------------|--------|--------|
| 4.2 Parking Area | Type | Light | Level (lux) | Height | Curfew |
| 4.2.1 Administration Lot | FCO ShCO | LPS, HPS, Amber CFL or LED, Filtered | ~3 | 6 m | Yes |
| 4.2.2 Visitor Lot < 10 cars | N/A | None | N/A | N/A | N/A |
| 4.2.3 Visitor Lot > 10 cars | FCO ShCO | LPS, HPS, Amber CFL or LED, Filtered | ~3 | 6 m | Yes |

N/A – not applicable

| Table 4.3 Roadway Illumination Guidelines (Maximum Values) | | | | | |
|---|-----------------|---|-------------|--------|--------|
| 4.3 Roadways | Type | Light | Level (lux) | Height | Curfew |
| 4.3.1 Class 1-3 roadways | None | N/A | N/A | N/A | N/A |
| 4.3.2 Class 1-3 roads & intersections | SCO Marker | LPS, HPS, Amber CFL or LED, Filtered | ~3 | 6 m | No |
| 4.3.3 Class 4-6 Roads & intersections | Signage only | N/A | N/A | N/A | N/A |

N/A – not applicable

| Table 4.4 Pathway Illumination Guidelines (Maximum Values) | | | | | |
|---|-------------|---|-------------|--------|--------|
| 4.4 Pathways | Type | Light | Level (lux) | Height | Curfew |
| 4.4.1 Pathways | None | None | N/A | N/A | N/A |
| 4.4.2 Illuminated Paths | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~1 lux | 1 m | Yes |
| 4.4.3 Main Pathways | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~1 lux | 1 m | No |

N/A – not applicable

| Table 4.5 Shoreline Illumination Guidelines (Maximum Values) | | | | | |
|---|-------------|---|-------------|--------|--------|
| 4.5 Waterways | Type | Light | Level (lux) | Height | Curfew |
| 4.5.1 General Areas | N/A | None | N/A | N/A | N/A |
| 4.5.2 Dock Bollards | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~1 lux | 1m | No |
| 4.5.3 Lock Facilities | FCO ShCO | Amber Incandescent, CFL or LED, Filtered | ~3 lux | 6 m | Yes |

* - lowest practical wattage

N/A – not applicable

| Table 4.6 Signage Illumination Guidelines (Maximum Values) | | | | | |
|---|----------------------------------|----------------------|-------------|--------|--------|
| 4.6 Signage | Type | Light | Level (lux) | Height | Curfew |
| 4.6.1 Building | Reflective, Light colour | Amber LED*, Filtered | ~3 lux | 1-2 m | Yes |
| 4.6.2 Navigation | Reflective, Light colour | Amber LED*, Filtered | ~3 lux | <1 m | N/A |
| 4.6.3 Information | Retro-reflective Light colour | Amber LED*, Filtered | ~3 lux | 1-2 m | Yes |

* Lowest wattage for about 3 lumen/ m² (0.3 lumen/ft²)

N/A – not applicable

| Table 4.8 Other Properties Illumination Guidelines Maximum Values) | | | | | |
|---|------|---|--------------------|--------|--------|
| 4.8 Other Properties | Type | Light* | Level (lux) | Height | Curfew |
| 4.8.1 Door Lights | FCO | Amber Incandescent, CFL or LED, Filtered | <3 | 1.5 m | Yes |
| 4.8.2 Yard Lights | FCO | LPS, HPS, Amber CFL or LED, Filtered | <3 | 6 m | Yes |
| 4.8.3 Municipal Lights | FCO | LPS, HPS, Amber CFL or LED, Filtered | ≤ minimum IESNA | TBD | No |

* Wattage of lamps should be based on illumination limits.

APPENDIX J - Power and Lumens to Comply with GOL

The following table provides a convenient guide for the selection of luminaires that will provide illumination that is compliant to this GOL.

The power levels are based on five mounting heights that correspond to typical applications. The power levels are further given for the two levels of average illumination (1 lx and 3 lx), which also correspond to applications typical of Preserves. Other levels may be interpolated.

To use the table,

- 1) Identify the application (mounting height and illumination).
- 2) Select the corresponding column for application and row for lamp type.
- 3) The lamp power is printed in the shaded part of the table.

| Applications | | | | | | | | | | |
|------------------------|--|-----|-------------------------------|------|----------|-----|-------------------|-----|-----|-----|
| | 1m x height = | | bollard or pathway light | | | | | | | |
| | 2.5m height = | | over-door light | | | | | | | |
| | 3m height = | | under-eve light | | | | | | | |
| | 4m height = | | over-head pathway light | | | | | | | |
| | 6m height = | | roadway and parking lot light | | | | | | | |
| Height Lux (GOL) | 1m | | 2.5m | | 3m | | 4m | | 6m | |
| | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 |
| LED | 0.1 | 0.2 | 0.4 | 1.2 | 0.6 | 1.7 | 1.0 | 3.1 | 2.3 | 6.9 |
| HPS | No lamps available. Do not use. | | | | | | | | | |
| CFL | No lamps available. Do not use. | | | | | | | | | 8.7 |
| Incandescent | 0.6 | 1.9 | 4.0 | 12.1 | 5.8 | 17 | 10 | 31 | 23 | 69 |
| Lumens (ave) | 6.4 | 19 | 40 | 120 | 58 | 174 | 103 | 309 | 231 | 694 |
| | | | | | | | | | | |
| Notes: | Pick lamp wattage closest to that in the table | | | | | | | | | |
| | Lumens based on average lux | | | | | | | | | |
| | Assumes 50% fixture efficiency and no backlight (50% of light is "lost") | | | | | | | | | |
| | Approx. coverage area = 1.5 x 3 mounting-heights = 4.5 x MH ² | | | | | | | | | |
| | Uniformity 3:1 => Max = 1.5 ave. lux and Min + 0.5 ave. lux | | | | | | | | | |
| Efficacy (lm/W) | LEDs - 100 | | HPS - 100 | | CFL - 80 | | Incandescent - 10 | | | |

These powers are only approximate and can be affected by the type of fixture, shielding, optics and degree of in-use degradation. However lamps using more than 2X these levels should not be used. Note that all lamps must only emit amber light.

APPENDIX K - Converting Non-Compliant Fixtures for GOL

Converting existing light fixtures to comply with the GOL may be done on a case-by-case basis. We will begin with an Edison screw socket. These take the standard consumer incandescent and compact fluorescent bulbs (E27 base).



The simplest way to convert from non-compliant to compliant lamps is to replace the white light incandescent, compact florescent and LED bulbs with amber bulbs - usually referred to as bug lights. The challenge with using off-the-shelf bug lights is that they tend to be too bright. Most applications in a Preserve require less than 50 lux.



| | |
|-----------------|-------------|
| 25 Incandescent | ~200 lumens |
| 13W CFL | ~550 lumens |
| 9W LED | ~800 lumens |

Therefore they require careful shielding to reduce the impact of the glare. Since they have very low wattage, they generate relatively little heat. Only the incandescent bulb may be too hot to touch (~55C). (Smaller incandescent bulbs are available at 8W.) This simplifies the materials that may be used for shields.



This example is made from cardboard with a coat of outdoor paint to protect it against weather. The exterior colour may be selected for it to blend in with the surroundings, the interior colour may be white to maximize the illumination, or black to reduce the brightness of the ground. If metal is used, care must be taken to prevent touching the electrical contacts at the bottom of the bulb.



Larger lamps, such as florescent tubes, may be filtered. The photographic filter material by Roscolux (Deep Straw #15) will filter out the blue light of typical white lamps. This amber coloured plastic foil can be purchased in sheets from www.bhphotovideo.com.



To assemble, line the interior of the U-shaped diffuser on a typical florescent tube fixture. To further reduce the glare and light trespass from the fixture, the interior sides of the diffusing plastic should be lined with light-blocking material (cardboard).

APPENDIX L - RASC Dark-Sky Protection Programs



Dark-Sky Preserves

- Limited use of artificial light at night
- Visitor facilities
- Visitor access at night
- Limiting artificial sky glow
- Stargazing and astronomy outreach programs
- Promotion of light pollution Abatement



Nocturnal Preserve

- Limited use of artificial light at night
- May have visitor facilities
- May have visitor access at night
- Limiting artificial sky glow
- Promotion of nocturnal environment



Urban Star Park

- Limited use of artificial light at night
- Visitor facilities
- Visitor access at night
- Noticeable impact of artificial sky glow
- Stargazing and astronomy outreach programs
- Promotion of light pollution Abatement

Royal Astronomical Society of Canada

Dark-Sky Site Application Requirements

Adopted by the RASC

March 2008

Revised Autumn 2018

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1.0 SCOPE

The Royal Astronomical Society of Canada (RASC) is the Canadian national astronomy organization established in 1868 devoted to the promotion of astronomy and allied sciences. In this capacity, the RASC encourages the protection of the quality of the night sky by minimizing light pollution.

The goal of the RASC Dark-Sky Program is to promote the reduction in light pollution, demonstrate low-impact lighting practices, improve the nocturnal environment for plants & wildlife, and protect and expand dark observing sites for astronomy. And to provide accessible locations for amateur and professional ecologists and the general public to experience the naturally dark night sky.

This document provides the information necessary to assess the suitability of a site for a Preserve Designation. It describes the application procedure and explains the contents of the Application.

The RASC recognizes the value of volunteers in establishing a Preserve. These Application Requirements will minimize administrative work for Park managers, local astronomy groups and the RASC as they prepare their application for the RASC Dark-Sky Program.

Currently, both urban and rural sites are contaminated at different levels by sky glow from artificial lighting. We thus distinguish three types of Dark-Sky Sites. All these sites must comply with the RASC Guidelines of Outdoor Lighting:

The three Dark-Sky Sites are:

Dark-sky Preserve: Sites with very dark skies. There is little or no sky glow and are generally far from urban centres, and are therefore less accessible to astronomers and the public. They usually contain public campgrounds and provide public outreach programs for the ecology of the night and astronomy.

Nocturnal Preserve: Some dark sites are remote with few resources for active outreach programs. Also, there may not be access for the visiting public. This designation is for the protection of the night for flora and fauna.

Urban Star Park: These are sites within, or close to, urban areas that are not considered "dark", but provide good access to the public.

All three designations are herein referred to as Preserves.

By promoting the use of these protected areas after dark, Preserves should see increased support from the public and usage during non-peak hours.

2.0 BACKGROUND

There is a growing need to identify and protect accessible areas that permit the public, amateur and professional ecologists, novice stargazers and astronomers to enjoy the night environment. There is also a growing need to identify these areas and protect them from light pollution.

The goal of this RASC Dark-Sky Site Program is to preserve or increase the quality of the natural night ecology and make accessible dark observing sites. It promotes the protection of these areas for the protection of wildlife and the enjoyment of current and future visitors.

The environmental impact of artificial lighting has been studied for many years and concludes that humans and wildlife are affected by light pollution. This research concludes that light can pollute the environment by fundamentally changing the ecosystem and thereby impacting the health and survival of wildlife. Many living creatures have evolved to require a day-night contrast to synchronize their biological rhythms. Wildlife takes advantage of the night for feeding, mating and migrating. These organisms have adapted to variations in night illumination from a dark sky to the brightness of a full Moon.

The light pollution from park lighting and neighbouring urban areas will affect the ecology of a park's environment. Some public parks are illuminated based on lighting "best practice" for urban areas and use illumination levels that far exceed the biological threshold (brightness of the Moon). Outdoor lighting prescribed by this program demonstrates the effectiveness of using less light.

Preserves shall be accessible to the public and all lighting fixtures and illumination within its borders are to comply with the RASC Guidelines for Outdoor Lighting. In some cases, where desired by the Applicant for special considerations and strict preservation, public access may be limited or denied within some portion of the Preserve.

2.1 Applicable Documents

Illumination Engineering Society of North America (IESNA)
IESNA Lighting Handbook, 10th edition, and RP-08

RASC Guidelines for Outdoor Lighting
(http://rasc.ca/sites/default/files/RASC-GOL_2018_0.pdf)

2.2 Abbreviations

ALAN - Artificial light at night
DSP - Dark-Sky Preserve
GOL - RASC Guidelines for Outdoor Lighting
IESNA - Illumination Engineering Society of North America
NP - Nocturnal Preserve
RASC - The Royal Astronomical Society of Canada
SQM - Sky Quality Meter (Unihedron Inc.)
USP - Urban Star Park

1.0 SCOPE

The Royal Astronomical Society of Canada (RASC) is the Canadian national astronomy organization established in 1868 devoted to the promotion of astronomy and allied sciences. In this capacity, the RASC encourages the protection of the quality of the night sky by minimizing light pollution.

The goal of the RASC Dark-Sky Program is to promote the reduction in light pollution, demonstrate low-impact lighting practices, improve the nocturnal environment for plants & wildlife, and protect and expand dark observing sites for astronomy. And to provide accessible locations for amateur and professional ecologists and the general public to experience the naturally dark night sky.

This document provides the information necessary to assess the suitability of a site for a Preserve Designation. It describes the application procedure and explains the contents of the Application.

The RASC recognizes the value of volunteers in establishing a Preserve. These Application Requirements will minimize administrative work for Park managers, local astronomy groups and the RASC as they prepare their application for the RASC Dark-Sky Program.

Currently, both urban and rural sites are contaminated at different levels by sky glow from artificial lighting. We thus distinguish three types of Dark-Sky Sites. All these sites must comply with the RASC Guidelines of Outdoor Lighting:

The three Dark-Sky Sites are:

Dark-sky Preserve: Sites with very dark skies. There is little or no sky glow and are generally far from urban centres, and are therefore less accessible to astronomers and the public. They usually contain public campgrounds and provide public outreach programs for the ecology of the night and astronomy.

Nocturnal Preserve: Some dark sites are remote with few resources for active outreach programs. Also, there may not be access for the visiting public. This designation is for the protection of the night for flora and fauna.

Urban Star Park: These are sites within, or close to, urban areas that are not considered "dark", but provide good access to the public.

All three designations are herein referred to as Preserves.

By promoting the use of these protected areas after dark, Preserves should see increased support from the public and usage during non-peak hours.

2.0 BACKGROUND

There is a growing need to identify and protect accessible areas that permit the public, amateur and professional ecologists, novice stargazers and astronomers to enjoy the night environment. There is also a growing need to identify these areas and protect them from light pollution.

The goal of this RASC Dark-Sky Site Program is to preserve or increase the quality of the natural night ecology and make accessible dark observing sites. It promotes the protection of these areas for the protection of wildlife and the enjoyment of current and future visitors.

The environmental impact of artificial lighting has been studied for many years and concludes that humans and wildlife are affected by light pollution. This research concludes that light can pollute the environment by fundamentally changing the ecosystem and thereby impacting the health and survival of wildlife. Many living creatures have evolved to require a day-night contrast to synchronize their biological rhythms. Wildlife takes advantage of the night for feeding, mating and migrating. These organisms have adapted to variations in night illumination from a dark sky to the brightness of a full Moon.

The light pollution from park lighting and neighbouring urban areas will affect the ecology of a park's environment. Some public parks are illuminated based on lighting "best practice" for urban areas and use illumination levels that far exceed the biological threshold (brightness of the Moon). Outdoor lighting prescribed by this program demonstrates the effectiveness of using less light.

Preserves shall be accessible to the public and all lighting fixtures and illumination within its borders are to comply with the RASC Guidelines for Outdoor Lighting. In some cases, where desired by the Applicant for special considerations and strict preservation, public access may be limited or denied within some portion of the Preserve.

2.1 Applicable Documents

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RASC Guidelines for Outdoor Lighting
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RASC - The Royal Astronomical Society of Canada
SQM - Sky Quality Meter (Unihedron Inc.)
USP - Urban Star Park

2.3 Definitions

Application - the document submitted by the Management of the proposed Preserve.

Applicant - the Management authority of the proposed Preserve.

Buffer Zone - the region within the Preserve under control of the Preserve Manager. The Buffer Zone is designed to prevent glare and light trespass from shining into the Core area. There may be more than one buffer zone in the Preserve.

Core - the region under control of the Preserve Manager surrounded by the Buffer Zone. There may be more than one core in the Preserve.

Dark Time – a period after which scheduled outdoor activity has ended and the need for outdoor lighting is reduced. Visitors are expected to minimize their outdoor activity to permit other visitors to sleep.

Dark-Sky Preserve (DSP) - the region that includes the DSP Buffer Zone and DSP Core that is under a single management with authority over policy, outdoor lighting and land use.

Filter – optical components or films that reduce the spectral components <500 nm from light to produce amber illumination.

Glare Zone - the sector around a light fixture between the horizon (90° from nadir) and 10° below the horizon.

Illumination - The amount of light that shines on a surface (lumens/m², or Lux).

LPA - light pollution abatement

Luminaire - the assembly of the enclosure, lamp, optics, power supply and controls.

Luminance - the amount of emitted light from a light source (cd/m²)

Nadir - a point directly below the light fixture

Nocturnal Preserve (NP) - the region that includes the NP Buffer Zone and NP Core that is under a single management with authority over policy, outdoor lighting and land use.

Observing Site - an area promoted as a good place to observe the sky. There may be several observing sites in a single Preserve

Photobiology – the study of the effects of light on biological systems

Photopic Vision – vision based on cone cells that have evolved for daytime vision and high illumination levels. Their peak sensitivity is at 555 nm

Preserve - an area under single management that is designated by the RASC as a Dark-Sky PreserveTM, Nocturnal PreserveTM or Urban Star ParkTM

Scotobiology – the study of the biological need for periods of darkness.

Scotopic Vision - vision based on rod cells that have evolved for night vision and low illumination levels. Their peak sensitivity is at 505 nm.

Sky Quality Meter (SQM) – a light meter designed specifically to measure the brightness of the night sky. These meters are available from Unihedron, Inc., or via a loan from the RASC. They use units of magnitudes/arcsec²

Urban Star Park (USP) - the region that includes the USP Buffer Zone and USP Core that is under a single management with authority over policy, outdoor lighting and land use.

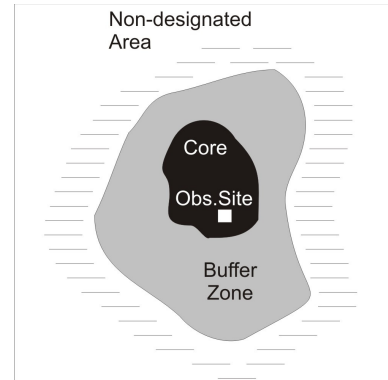
Zenith - a point directly overhead, or 90° up from the horizon.

3.0 Management Requirements

The Preserve shall be under the management of a single entity to ensure full adherence to these Guidelines and the RASC-GOL.

A Preserve is a protected area with a Core and a Buffer Zone. The Buffer Zone prevents light from outside the Preserve from reaching the Core area. The Manager of the Preserve identifies specific observing sites for night observing that are inside the Core area.

The establishment of a Preserve is a partnership between the Management, local stargazers and astronomers, and neighbouring municipalities, and it requires their active support. There are four principal requirements for a Preserve: compliance to the RASC-GOL, accessibility, quality of the night sky and in the case of a DSP and USP, an active outreach program. NP managers may not have the resources to provide full access or an outreach program, but may do so if such resources are available.



3.1 Outdoor Lighting

The RASC-GOL respects and protects the need for naturally dark nights, yet it allows sufficient lighting for safety and navigation within the Preserve.

These Guidelines define the spectrum (colour), brightness (illumination), shielding (extent of light) and the schedule (timing) that artificial light is used. These Guidelines are free to be downloaded from the RASC website (<https://rasc.ca/dark-sky-site-guidelines>).

The Applicant shall ensure that all lighting in the Preserve complies with the RASC-GOL. Non-compliant lighting shall be reported in the appropriate section of the Application with the reasons for lack of compliance. The Applicant shall also provide a schedule for all non-compliant luminaires to reach compliance. All remaining non-compliant lights shall be compliant within 1.5 years of the Designation.

If the Applicant believes specific luminaires cannot be compliant, an explanation shall be included in the Application. The RASC may choose to waive or amend any of these guidelines for a specific application provided that the integrity of the Preserve programme is not jeopardized.

3.2 Accessibility

The Applicant of a DSP and USP must ensure the core area remains accessible after the end of twilight. This will require that gates and parking lots remain open for visitors. However, where desired by the Applicant for special considerations and strict preservation, public access may be limited or denied within some portion of the Preserve.

There shall be appropriate signage to help visitors navigate the Core of the Preserve. This signage shall conform to the RASC-GOL.

3.3 Quality of a Dark Sky

The illumination by artificial lighting in a Core and Buffer Zone shall comply with the RASC-GOL.

All artificial lighting within the Core shall not affect the natural quality of the night sky in terms of diffuse sky glow, luminance (glare) and illumination (surface brightness). And, shields shall limit the extent of the luminance and illumination to only where needed for the permitted human activity.

Sky quality readings shall be used to assess the darkness of the sky above the Preserve. However, a brightness measurement of the zenith will give only a partial indication of the quality of the sky because it provides no indication of sky glow on the horizon. Currently, the only form of documentation for recording the sky glow on the horizon is with descriptions by experienced observers and with photographic images around the horizon that show the stars in the sky.

Thus, the sky quality shall be periodically measured using a sky quality meter (SQM) and recorded with images of the night horizon. These shall be submitted to the RASC-LPA Committee at least once every two years to assess the improvement in the sky resulting from improved lighting in the Preserve and outreach to neighbouring urban areas.

3.4 Outreach Programs

For Dark-sky Preserves and Urban Star Parks, Management of the Preserve shall develop and manage two outreach programs designed to increase awareness and garner support from the public and municipalities.

Public outreach is for the visiting public and will consist of raising awareness of stargazing or other night activities, and raising awareness of the connection of dark skies to night ecology. Knowledgeable staff or members of local astronomy clubs or other organizations may contribute to this activity. Topics may include, but should not be limited to: mythology, star tours, telescope observation, indoor presentations, walking tours after dark, experiencing sounds of the night and night wildlife and the explanation of how artificial lighting affects the ecology.

If volunteers are used by Management to assist in public outreach activities, then all parties may sign a Memorandum of Understanding stating the terms of the voluntary service. See Appendix B for a suggested draft a MOU. A formal agreement may also be done through normal programming contracts used by the Preserve.

Municipal outreach is to raise awareness of the impact of excessive artificial light on the night environment in order to protect the Preserve from light pollution from neighbouring areas and municipalities. Management of the Preserve shall encourage the reduction the light pollution that is visible from the Preserve. This is an investment to protect the ecological integrity of the Preserve and should focus on possible or planned development adjacent the park that may degrade the quality of the night sky if lighting is not properly designed against causing excessive sky glow. Degradation of the sky darkness may effect certification or classification of the park.

3.5 Nomination Process

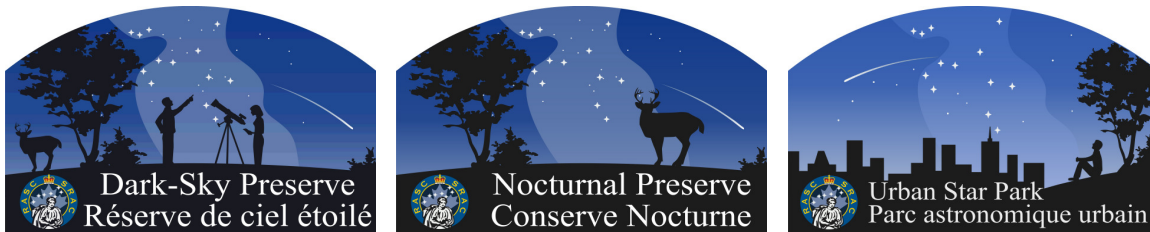
The Manager of the proposed Preserve may submit the Application for consideration to the RASC including the documentation listed in Table 4.0 and defined within Chapter 4, and other materials that may be requested by the RASC to help them judge the suitability of the proposed Preserve.

The RASC will acknowledge the receipt of the Application and will review it in a timely manner. Comments and questions will be transmitted to the Manager of the proposed Preserve. The manager will have the opportunity to revise their Application based on these questions and comments. The decision of the RASC will be communicated to the Manager. If an Applicant requests a designation by deadline date (as for an official announcement), the RASC will attempt to provide a decision ahead of that date.

3.6 Naming of the Preserve

The name of the Preserve shall be determined by the RASC in consultation with the Applicant. Generally, the Preserve will be named after the geographical region. Alternatively, in the case of an existing Park, the Preserve will be given the name of the park.

Upon the award of the Designation, the Preserve should display a sign identifying it as a RASC DSP, USP or NP. The RASC-provided logo may be used by the Preserve on their signage and communiqué, at discretion of the Applicant.



3.7 Biennial Reporting

A Biennial Report (once every 2-years) is required from the Manager of the Preserve to help the RASC monitor and promote the Preserve, to measure current compliance, or to improvement on compliance if there were outstanding deficiencies identified on the Application or previous Report. The RASC will attempt to work with the Preserve Management to resolve these issues and improve the Preserve.

3.8 Revision to Designation

It may become necessary to review the Preserve designation due to changes in priorities of any signatory of the MOU, or changes in the lighting within or beyond the Preserve boundaries, or policies regarding access and lighting by the Management.

If the Preserve is deemed to be no longer viable by either the sponsors of the Park or the RASC, the Designation will be rescinded and a letter from the RASC will notify the Manager. The Park will be required to remove signage referring to the Preserve Designation and the Park shall no longer promote itself as a Preserve.

4.0 APPLICATION REQUIREMENTS

This chapter presents the required content in the Preserve Application.

It should also be noted that the establishment of the Preserve is based on its current merits and should reflect the current state of the site, not the future of the site. As such, the proposed Preserve should be compliant to the GOL (Ref. Section 2.1).

The Preserve may be expanded in the future as more area becomes compliant to the GOL.

There are ten sections to the Application listed in the following Table. This information locates, defines, describes and documents the Preserve, which are further described in the following subsections. This information will help the RASC assess the status of the current property, the sky quality and the state of the outdoor lighting, and it will be used in promoting the Preserve to other organizations and the public. It will also be used as a baseline to compare the future state of the Preserve.

Preserve Nomination Documentation List

- 4.1) Statement of compliance to the RASC-GOL
- 4.2) Location and description of the proposed Preserve
- 4.3) Zenith sky quality measurements (locate reading on map)
- 4.4) Public outreach plan (education)
- 4.5) Municipal outreach plan
- 4.6) Existing light fixture inventory (lighting audit)
- 4.7) Lighting plan
- 4.8) Images of the Preserve's observing sites taken during the day and night
- 4.9) Memorandum of Understanding between partners
- 4.10) Letters of support and commitment from neighbouring municipalities

4.1 Statement of Compliance to GOL

This section assesses the Applicants understanding of the RASC-GOL and its readiness to become a Preserve. The GOL was developed to minimize the contamination of the area by artificial lighting. It addresses the needs of wildlife and astronomers.

State whether the proposed Preserve is compliant to the GOL. The application should be specific about the non-compliances with reference to the outdoor luminaire inventory. The basis for the acceptance will vary depending on the total application. The RASC may choose to waive or amend any sections of the GOL for a specific application provided that the integrity of the Preserve programme is not jeopardized.

4.2 Scale Map of Preserve and Surroundings

Where is the proposed Preserve? The RASC requires sufficiently detailed, scaled and labelled maps and directions in order to promote the Preserve. These maps must show the regional context of the Preserve, the total area, the latitude and longitude and the

boundaries between the Buffer Zone and the Core. They should plot the location of observing sites, including access roads, campgrounds (if any), and other facilities that are mentioned in the Application. Additional larger scaled maps of areas within the Preserve may be used to provide more detail.

4.3 Zenith Sky Quality Measurements

The RASC or local experienced observers designated by the RASC will use the sky quality measurements, obtained with the Unihedron Sky Quality Meter, to rate the quality of the observing site(s). The locations where these readings were taken should be marked on a map of the Preserve. These readings may be listed in a table with cross-references to their location. Reading shall be taken after nautical twilight ends, and with no Moon in the sky. There shall be dates and times when these readings were made since they will vary by time night and season. These reading will also be used to benchmark sky glow in the area. Subsequent biennial readings will document improvements over time.

4.4 Public Outreach

The RASC Preserve Program is designed to improve or restore a park to more natural darkness through appropriate use of outdoor light, and to improve the health and welfare of flora and fauna, and to provide an improved visitor experience at night. This is achieved through changes in lighting practices and through educational programming. Visitors to the Preserve may not be aware of these topics and will benefit from the experience. The DSP and USP shall be open after dark to encourage the use of the site for stargazing, astronomy and night walks so visitors can experience the night.

Literature should be made available to the public during these outreach sessions and in kiosks (if available). Astronomy and light pollution information may be obtained from the RASC on a cost recovery basis.

Night programs the DSP and USP may offer the public includes, but is not limited to, the promotion of a healthy nocturnal environment and the relationship between the sky-lore of the First Nations and other cultures. Reference may be made to the new science of scotobiology and how it is changing our awareness of our need for periods of darkness. Management is encouraged to contact other DSPs and USPs for more ideas. Every Preserve is different, so some programs may be more appropriate than others.

4.5 Municipal Outreach

Urban growth outside Park boundaries can severely contaminate the night sky over the Preserve with artificial sky glow. An active Municipal Outreach Program should be attempted to protect the Preserve from increases in urban sky glow, and to improve the quality of the night sky into the future.

Managers, with the support and assistance of local astronomy groups and scotobiologists, should give presentations to neighbouring municipalities to promote the use of: full cut-off fixtures, low colour temperature lighting and low illumination levels in order to protect and improve the quality of the night sky over the Preserve. These presentations will, as a minimum, inform surrounding municipalities of the pending Preserve and will at least register the request for the municipality to participate in active light pollution abatement

efforts that will help protect the Preserve. Advice and digital files of presentation materials may be obtained from the RASC.

Repeated reminders of the adverse impact of outdoor lighting on the environment and human health are more effective than a single mention of it in the media. Therefore, Managers and local partners should regularly raise the issue of light pollution in the local and regional media and in the business community.

4.6 Existing Luminaire Inventory

This is perhaps the most time consuming part of the Application, but it is also one of the most important.

Light fixtures are regularly installed but rarely removed. They have been installed prior to any understanding of the impact they have on the night ecology. The site may have accumulated dozens or hundreds of outdoor lights - many of which are no longer necessary.

This information should be presented in tabular form (MS-Excel for example) that includes the location, quantity, wattage, shielding and lamp type (colour, HPS, LED, etc.) for all outdoor luminaires in the Buffer and Core areas of the Preserve. It should also provide the reason for the light and whether it is compliant, or not. The luminaires should be plotted and referenced on supporting maps. This inventory must be updated and submitted to the RASC every 2-years.

4.7 Lighting Plan

This section presents the plan and schedule to make all luminaires compliant with the GOL. All non-conforming lighting fixtures should be removed, replaced, or modified. **This work must be scheduled for completion before the end of the fiscal year following the designation - typically 1.5 years.** Explanations for the submitted schedule and any delayed compliance should be included in this section.

4.8 Images of Proposed Observing Sites

There should be daytime and night panoramas (stitched together from a series of images) of the Observing Sites showing the cardinal directions, tree line, bushes, buildings, etc.

There are two purposes for these images: they will be used on the RASC web page for promotion of the site to potential visitors by showing what the site looks like.

A night panorama will also document the existence of sky glow around the horizon. They will be used as a benchmark against which future images can be compared to show improvement or degradation of the site. The daytime and night panoramas should be presented with the same scale so they can be compared.

4.9 Memorandum of Understanding

If the Preserve's staff is not familiar with stargazing or the nocturnal wildlife, the Management should reach out to local astronomy and wildlife groups to help in this endeavour. The Preserve should actively advertise outreach that includes these activities.

Letters of interest in partnering with the Preserve should be included in the Application. A Memorandum of Understanding (MOU) between the Management of the Preserve Management and the volunteers may be used to clarify expectations and avoid disagreements (APPENDIX B).

The Applicant should also obtain MOUs from all independent businesses or lessees operating within the Park who may have lighting at their establishments. It will help them come to an understanding so they will also comply with the requirements of the Preserve (GOL) including potential retrofits and other requirements of the Preserve.

An MOU should also be signed between the Park Management and other park departments who supply buildings or lighting to the Park such that they also be informed that their buildings and lighting must comply with the GOL requirements of the Preserve, if they are to be installed in the Preserve.

Furthermore, all electrical contractors or companies tendering work within the Preserve shall be given a copy of the RASC-GOL and be instructed to comply.

4.10 Letters of Support and Commitment

Future protection of the Preserve depends on the policies of neighbours. The Applicant should attempt to solicit letters of support and commitments to reducing the light pollution from neighbouring municipalities or for them to potentially implement policies in their bylaws to help protect the Preserve in the future.

Partners in the region may also be called upon to support the Preserve with contributions to the outreach activities and public promotion of the Preserve. Letters from these groups should be included in addition to the MOUs citing this support and commitment.

4.11 Biennial Report

The Manager of the Preserve shall submit a Biennial Report so that the RASC may monitor the site and outreach activities. It should be submitted to the RASC National Office on the second anniversary of the designation, and every two years thereafter.

The contents of the Report shall include the following.

1) Name, title and contact information of the Preserve Manager. This will typically be the Superintendent of a National or Provincial Park, the owner or manager of a commercial park or manager of a protected area.

Rationale: The management personnel may change as they continue along their career path. The RASC requires the current contact person responsible for the Preserve for communication on matters concerning the Preserve.

2) The revised audit of outdoor luminaires in the Preserve.

Rationale: The original Application contained a table of all outdoor lighting in the Preserve indicating their compliance to the GOL, and with a schedule for their conversion to compliance. These luminaires, and any others that were added should be monitored. This can be an edited version of the spreadsheet file that was submitted in the original application. Generally after two years from the Designation, all initially non-compliant luminaires should have been modified, removed or replaced with compliant luminaires. Luminaires that remain non-compliant should be highlighted with the reason for continued non-compliance.

3) Sky Quality Readings. The quality of the sky is measured with a Sky Quality Meter (SQM, Unihedron, Inc.).

The SQM measures the brightness of the sky at the zenith. If left uncontrolled this sky glow generally increases with the increase in light pollution within a Park and from neighbouring municipalities. Comparing measurements at least every two years will show the success of the Preserve in protecting the night environment.

To allow direct comparisons over time, readings should be made at the Observing site(s) and other areas that were measured in the original Application.

3) List and describe of Public Outreach Activities for night ecology and astronomy.

This should include the nature of the outreach event(s) and an estimate of the number of visitors taking part in the event(s) and the dates. It should also describe activities of volunteers in their outreach programs. If the event is regularly scheduled, then they may be collapsed into a single entry and identified as recurring. The RASC will use this information to help guide the development of outreach resources that could be made available to Preserves to assist in the user experience.

4) List and describe Municipal Outreach Activities that concern light pollution.

Municipalities play a significant role in maintaining the ecological integrity of a Preserve. Neighbouring municipalities may economically benefit from the Preserve, so it is in the best interests of both parties to have semi-regular communications and meetings. However municipal officials may not know or understand the needs of the Park - especially after municipal elections.

The Preserve Manager is required to meet with neighbours to ensure the protection of the night environment in the park. The report on these meetings should highlight the discussions on outdoor lighting that may shine into the Park (glare or light trespass) or over the park as sky glow. (If sky glow over the urban area is visible from the Preserve, then it is affecting both the ecology of the Preserve and the user experience.)

5) Annual Reports

Include, or provide a link to the Park's preceding Annual Reports to their provincial or federal agencies. Commercial parks should provide a copy of their Preserve-related activity. Proprietary material that may form part of their Commercial Annual Report maybe removed. It is expected that Annual Reports will mention and promote the Park as a Preserve.

APPENDIX A - Scotobiology

STUDY OF THE BIOLOGICAL NEED FOR PERIODS OF DARKNESS

An outline for public information prepared by Dr. R.G.S. Bidwell, Wallace, NS, 2008

What is Scotobiology?

The concept of scotobiology as a science was developed at a conference on light pollution held in Muskoka, Ontario, in 2003. It was recognised that the underlying principle was the deleterious effect of light pollution on the operation of biological systems, ranging from their biochemistry and physiology to their social behaviour. Scotobiology is the study of biological systems that require nightly darkness for their effective performance; systems that are inhibited or prevented from operating by light.

Why is Scotobiology important?

Virtually all biological systems evolved in an environment of alternating light and darkness. Furthermore, the light/dark periods in temperate zones vary with the seasons. Organisms have evolved to use the variations in the length of day and night to integrate their physiological and social behaviour with the seasons. Many organisms measure specifically the length of the night, and light pollution may prevent them from determining the season, with serious or deadly consequences. For this reason light pollution is recognised as being a major component of global pollution, and scotobiology, the study of its specific effects on organisms, has now become an important branch of biological research.

Summary of specific scotobiological responses

Insects: Insects tend to fly towards light. Light pollution thus causes insects to concentrate around bright lights at night with several serious consequences. First, they become easy prey for birds and predacious insects. Insect numbers are reduced by their disorientation and death around lights, and also because they are concentrated where natural predators have an unnatural advantage to capture them. This reduction in insect populations has been found to affect the populations of animals not strongly attracted to light, including frogs, salamanders, bats, some birds and small mammals. In addition, the mating and breeding habits of some insects require darkness, so that light pollution can interfere or prohibit normal reproduction. Finally, the migration habits and paths of many insects are affected by light pollution with resulting population depletion. The huge piles of dead insects such as mayflies that are found under streetlights in springtime give some idea of the extent of damage such lights can cause.

Birds: Many birds are powerfully attracted to lights, and over a hundred million birds die from collisions with illuminated structures in North America alone every year. The actual loss of bird populations is hard to calculate, but it is significantly large. Furthermore, as with insects, bird migration patterns may be affected by light pollution because the birds may become disoriented and unable to follow their normal flight paths. Finally, the concentration of birds around lights also encourages animals and birds of prey that feed on smaller birds, resulting in still further reductions in the population numbers of migrating birds.

Animals: The behaviour of many animals is seriously affected by light pollution. Mating, hunting and feeding habits of wolves and other large animals are altered, with resulting decreases in population. Salamanders, frogs and other amphibians, many of which are already under serious threat from chemical pollution, are subject to impacts from even low levels of artificial night lighting on their physiology, ecology, behaviour and evolution. It is very likely that the behaviour of many if not most of our wild animals is similarly and negatively affected by even low levels of light pollution.

Plants: Plants are seriously affected by light pollution. Probably the most important aspects of a plant's reaction to and interpretation of darkness are expressed in its developmental behaviour: flowering, dormancy and the onset of senescence. The plant's ability to measure and respond to day length is crucial in enabling it to dovetail its developmental behaviour with the seasons. We are all aware of "long-day" and "short-day" plants. What is not so widely known is that plants do not measure or react to the length of the day. Instead, they measure and respond to night length, i.e. the duration of darkness. So short-day plants really require long nights, and should properly be called long-night plants. The problem for short-day/long-night plants arises from the fact that if they are illuminated briefly during a long night, they interpret the event as if they had experienced two short nights, rather than one long night with an interruption. As a result, their flowering and developmental patterns may be completely interrupted. Short-day plants normally bloom in the fall, as the days shorten, and they respond to the lengthening nights to initiate the onset of flowering. As the nights further lengthen, they begin a period of dormancy, which enables them to withstand the rigours of winter. Thus, if the nights are interrupted by light pollution, the consequences can be severe or deadly. Furthermore, the effect of successive experiences of nightly illumination is cumulative. It follows that light pollution, particularly if it is repetitive on a nightly basis, can seriously affect the development, flowering and dormancy – and so the very existence – of short-day (long-night) plants.

Human Health: Humans, like other animals, are affected by nightly light pollution, and human health is more severely affected by light pollution than is generally realised. Human hormone regulation, physiology and behaviour evolved in a diurnal pattern of day and night. The normal operation of wake/sleep cycles, hormone cycles, the immune system and other biochemical behaviour, depends on the daily alternation of light and dark, and may be severely damaged by nighttime illumination. It has been shown that the human immune system works more strongly during the day to produce antibodies that protect the body against microbial invasion, which is normally more likely to occur during the activities of the day. At night the immune system switches from a defensive to a repair mode, and killer cells then become more active in attacking tumours as well as infections that may not have been successfully prevented during the day. Light pollution may thus compromise the operation of human hormone and immune systems leading to increased incidence of cancer and other diseases, as well as to other physical as well as psychological disorders including mental illness, psychiatric instability, and such problems as seasonal depression (SAD). This means that even turning on a night-light or bedside lamp may have negative effects on a person's health. This may have little relevance to light pollution in parks, but it is important to note that bright lights in camp-sites may be unhealthy to humans as well as to the wildlife inhabitants of the park.

Sociology: Human sociology is affected by light pollution. It is now commonplace to be concerned by the fact that few people alive today have had the opportunity to experience the glory of the night sky. This is sad for citizens of “advanced” or wealthy countries, but it is a serious loss of the cultural heritage of aboriginal peoples and those who live (or lived) under natural and unpolluted conditions. The darkness of the night and the ability to commune with the natural beauty of the moon and stars and the glories of the aurora are necessary for the well-being and sociological wholeness of native peoples all over the world. Most of those who live in places like Canada and the United States of America can no longer experience the wholeness of dark skies. Parks that emphasise dark skies are thus an essential part of our human and environmental heritage.

Astronomy: It hardly needs to be mentioned that astronomy depends on dark skies and the virtual absence of light pollution. Both the importance and cost of astronomical research to our present society are very high, and are as important as environmental concerns for the control of light pollution.

Prospects for abatement of light pollution: the importance of public opinion

Public pressure is the surest way to reduce light pollution. This will assist releasing more funds for basic research in scotobiology, and for helping to develop legislation to control light pollution if that is found to be necessary. Light pollution can be controlled by reducing unnecessary lighting, focussing required lighting where needed rather than shining it in every direction, and the use of directional light shades where appropriate. Lower levels of illumination are often advantageous, and have been found to provide better safety and protection for pedestrians than the normally used bright streetlights. All these approaches are already being developed and put to use, but the continued application of public pressure is essential to reduce not only the actual light pollution and the cost in dollars for unnecessary lights, but also to reduce the environmental pollution that results from making the electricity to power them. Anything that can be done to stimulate public appreciation of the dangers and costs of light pollution will be well worth the effort.

If there are further questions about scotobiology, please call:

Robert Dick, Canadian Scotobiology Group 800-278-2032, rdick@csbg.ca

APPENDIX B - Memorandum of Understanding

These are two samples for MOUs

MEMORANDUM OF UNDERSTANDING

This agreement is between:

Responsible Authority for the
Facility Provider

Organization

Date

and

Responsible Authority for the
Outreach Contributor

Organization

Date

The Outreach Contributor agrees to provide outreach assistance to Facility Provider at a mutually agreed upon schedule and location.

In return for providing public outreach assistance from Outreach Contributor, the Facility Provider agrees to provide free access to the facility and campgrounds to the Outreach Contributors providing outreach assistance for the duration of the activity plus at least one night to prevent the need for late night travel.

The Facility Provider agrees to compensate the Outreach Contributor for travel expenses (gas and food) accrued in the course of providing the outreach assistance.

This Memorandum of Understanding (MOU) shall remain in effect if one or both a managing officers are replaced. This MOU shall be dissolved with mutual consent of both organizations.

If this MOU is dissolved, the Royal Astronomical Society of Canada shall be notified within one month of the dissolution so they may re-assess the Preserve designation.

It is the responsibility of the Facility Provider to promote the outreach event, and provide the following:

A suitable site,
Electric power,
Public facilities,

and to inform the Outreach contributor what items will be supplied for the event.

The volunteers may promote the RASC and provide handouts to the public.

MEMORANDUM OF UNDERSTANDING**MANAGING AUTHORITY OF DSP (FACILITY PROVIDER)**

-and-

ASTRONOMY SERVICE PROVIDER (OUTREACH CONTRIBUTOR)

This agreement is made this _____ day of _____, 2017

WHEREAS, The FACILITY PROVIDER has applied to become designated as a Dark-Sky Preserve (DSP) by the Royal Astronomical Society of Canada, and

AND WHEREAS, a Memorandum of Understanding (MOU) between the FACILITY PROVIDER and the OUTREACH CONTRIBUTOR will outline the roles and

responsibilities of the parties in order to become and maintain the DSP designation,

NOW, THEREFORE, BE IT RESOLVED THAT the FACILITY PROVIDER and the OUTREACH CONTRIBUTOR, collectively referred to as the “parties”, agree as follows:

1. Purpose.

The purpose of this MOU is to articulate the role and responsibilities between the parties in the accomplishment of adhering to the protocols of the RASC’s DSP Program as laid out in the Guidelines for Outdoor Light in DSPs (RASC-DSP-GOL) in order to maintain the OUTREACH CONTRIBUTOR’s designation of the FACILITY PROVIDER as a DSP.

2. Statement of Mutual Benefit and Interests.

The parties recognize the importance of an exceptional dedication to the preservation of the night sky through the implementation and enforcement of quality lighting codes, dark-sky education, and citizen support for dark skies, and that achieving designation as a DSP provides many benefits to wildlife and the community including preservation of the night sky and reductions in night time light pollution.

3. Duties of the Parties.

The parties agree to work together to maintain the DSP designation and to uphold the tenets of dark-sky policies as described by the RASC’s DSP Program as laid out in the Guidelines for Outdoor Light in DSPs (RASC-DSP-GOL).

4. General Provisions.

The parties agree to the following:

- The parties will consult on all installations of new outdoor lighting fixtures, retrofit and replacement or relocation of all existing outdoor lighting fixtures or increases in light intensity of any existing outdoor lighting fixtures on FACILITY PROVIDER properties;
- The parties will consult with the RASC Light Pollution Abatement Committee when determining proper adaptive controls and curfews on outdoor lighting fixtures where appropriate.
- The parties will work together to support dark skies and good lighting in public communications promoting the concepts of dark skies and good lighting.

- The parties shall work together to maintain a commitment to providing dark-sky education programs by:
 - Planning and execution of at least two community dark sky awareness events per year;
 - Inclusion of dark-sky awareness documents with other community informational documents that are made available to FACILITY PROVIDER volunteers and visitors;
 - Developing and presenting dark-sky events with activities tailored for school groups visiting the FACILITY PROVIDER and within its outreach programs.
- The parties shall work together to investigate the possibility of establishing and maintaining a sky-brightness measurement program which might include the installation of light monitoring devices.
- The parties shall work together to prepare an annual report with basic information on the effects of the DSP designation on wildlife on the FACILITY PROVIDER.

5. MOU Effective Date and Termination.

This MOU between the parties takes effect upon the signature of both parties. The parties agree that January 1 shall be considered the "Anniversary Date" of this MOU. The MOU should be renewed annually on the Anniversary Date unless either party provides notice of termination to the other by September 30 of the prior year.

FACILITY PROVIDER
Management Authority

OUTREACH CONTRIBUTOR

CEO

CEO

APPENDIX C - Sample Table Current Luminaire Inventory

| LOCATION | WATTAGE | No. UNITS | SHIELDING | LAMP | COMPLIANCE Before / After | Comments |
|-----------------------------|---------|-----------|--------------|--------------|------------------------------|--|
| Admin. Bldg. | | | | | | |
| Front door | 125 | 3 | Unshielded | HPS | no / yes | To be replaced with FCO 2W Amber LED |
| Perimeter Lighting | 3 | 5 | FCO | amber LED | yes / yes | wallpacks (EcoLights.ca) |
| | 35 | 2 | | LPS | yes / yes | not working |
| | 50 | 4 | Not Shielded | Florescent | no / yes | To be FCO shielded To be amber filtered |
| Maintenance Compound | 100 | | Unshielded. | HPS | no / yes | Replace with FCO in next maintenance cycle |
| Garage | | 1 | Not shielded | Incandescent | no / yes | To be replaced with FCO in next maintenance cycle |
| Campground | 100 | 2 | Not shielded | HPS | no / yes | Replaced with FCO amber LED, 20W before beginning of next camping season |
| Showers | 5 | 2 | FCO | White LED | no / yes | To be filtered this camping season |
| Toilet | 2 | | FCO | Amber LED | yes / yes | |
| #1 Parking Lot | 125 | 1 | | HPS | yes | Currently burned out and will be replaced with FCO Amber LED |
| Access Roads | 50 | | semi cut-off | HPS | no | Use for special event only - safety |
| Gate Kiosk | 35 | 1 | FCO | HPS | yes | |

NOTES:

All shall be made to comply before the end of current camping season unless otherwise stated.

Current maintenance cycle - April 2018-November 2018

Next maintenance cycle - April 2019-November 2019