Final Report: Nano Paint

DECEMBER 30

New Mobility
Strategic Planning and Policy
TransLink

Executive Summary

- Nano paint is type of paint that contains tiny particles at the nanometer scale (a billionth of a meter). It is gaining popularity worldwide where eco-friendly and energy efficiency is in focus such as Europe and North America. Nano painted surface has unique properties such as self-cleaning, anti-corrosion and thermal benefits. By reflecting sunlight and improving insulation, Nano paint can reduce the need for air conditioning in summer and heating in winter. This lowers energy consumption, often powered by fossil fuels, and consequently decreases greenhouse gas emissions.

- While there are a lot of known benefits of nano paint, this pilot focused on the effectiveness of nano paint in reducing surface heat and assess capability in thermal insulation in providing heat-reflective properties to maintain cooler temperature and improve energy efficiency. If successful, there are possible applications of the paint in the transportation system such as in different transit infrastructures across Metro Vancouver.

- The pilot was a partnership between TransLink, Low Carbon Business Association (LCBA) and Vancouver Economic Commission (VEC) through Project Greenlight and delivered in two phases.

- The outcome of the pilot study recommends considering annual sun-exposure as a significant factor for considering use of the nano paint. The current cost of the paint and lack of green incentives is prohibitive in rolling out the technology in buildings that do not see significant heat outside of the summer season. It is also useful to explore the other properties of the technology such as self-cleaning, corrosion resistance and durability.

Project Overview:

Metro Vancouver has experienced hotter than usual summer days in the past few years. Climate change made extreme heat more common in the region which puts the citizens at risk for heat related illness particularly among vulnerable populations[1].

The region is collectively looking for ways to reduce the negative impact of extreme heat on people and environment by adapting buildings to be able to withstand the extreme heat that is being anticipated to be more common in the next 30 years.

Application of nano paint can be one of the ways the region can prepare for extreme heat. More specifically, addressing the urban heat island effect (UHI). Large urban settlements with greatly modified environments experience higher temperatures than outlying areas. This phenomenon can raise temperatures from 5 to 10 degrees Celsius amplifying the effect of heat waves. It is predicted that 30+ degrees Celsius days in Vancouver will increase from 1 to 13 in the next 30 years as an effect of climate change[2].

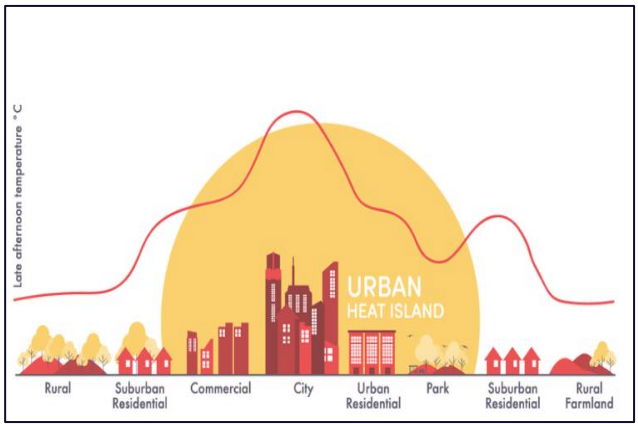


Figure 1: Urban Heat Island Effect

By improving thermal management in buildings and surfaces, nano paint can reflect significant portions of solar radiation preventing buildings from absorbing excess heat. It also helps reduce heat gain in buildings thus lowering ambient temperature and preventing accumulation of heat.

Cities like Toronto[3], Los Angeles, New York, Melbourne, and Athens have started cool roof programs to address the urban heat island (UHI) effect and improve energy efficiency. Incentives such as rebates to consumers, mandatory adaption of cool roofs for municipal buildings and include use of cool roof as one of the tools in promoting sustainability and combating climate change.

Nano paint claims a handful of benefits. Due to time constraint and limited scope of this pilot, the project team focused on the thermal insulation aspects of the use of nano paint specifically in the properties that will help combat Urban Heat Island effect. There are other

[1] https://vancouver.ca/files/cov/vancouver-climate-change-adaptation-strategy-2024-25.pdf
[2] https://climateatlas.ca/urban-heat-island-effect
[3] https://www.toronto.ca/services-payments/water-environment/environmental-grants-incentives/green-your-roof/

benefits of the paint as mentioned below but the team believe that for the purpose of transit infrastructure – UHI reduction offers the biggest advantage thus the focus of this study.

Benefits of using nano paint

- Thermal Insulation
- Energy savings
- Ease of application
- Durability
- Self-Cleaning
- Anti-bacterial
- Air purification
- Maintenance reduction

The purpose of this pilot was to gain better understanding of applied use of nano paint and how it can be a tool to cool transit infrastructures in Metro Vancouver.

There are two phases in the pilot. The first phase was completed in 2023. The objective was to test solar reflectance or the ability for the surface to deflect heat. FN Nano has a solar reflectance of 0.79 which means that for every 1 particle of solar unit 79% of this is deflected.

It has potential use in transit infrastructures exposed under the sun for majority of the year. To be able to confirm effectiveness the project team contracted an independent contractor to measure surface temperature in the roof using thermal scanner.

The second phase (2024) was to test thermal emittance or the ability to deflect back the heat absorbed by the surface. This will prevent heat from reaching the interior of the building thus cooling the interior.

To perform this test, the team installed thermometers in the building to measure the ambient temperature inside the building and compared it to the temperature outside of the building and baselining this against the Metro Vancouver historical weather.

Timeline and Budget

Phase 1 (2023)

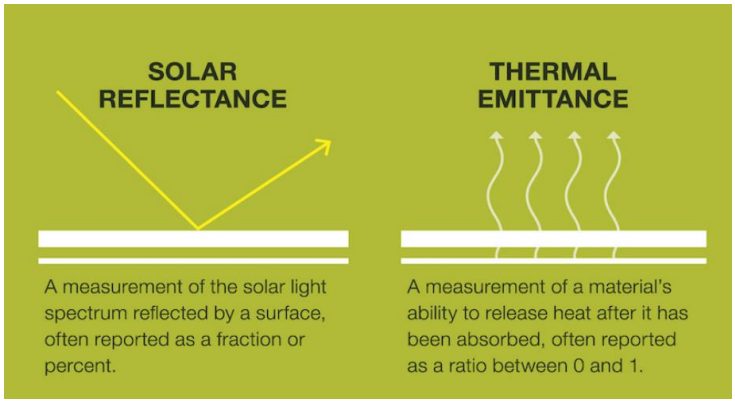
Phase 2 (2024)

Budget	Phase 1	Phase 2	Totals
Nano Paint	$ 6,204	$ 9,261	$ 15,465
Thermometer	-	$ 238	$ 238
Painter	$ 20,000	$ 29,500	$ 49,500
Thermal Scanner	Paid by FN Nano	-	-
Total Cost for Pilot	**$ 26,204**	**$ 38,999**	**$ 65,203**

Project Design

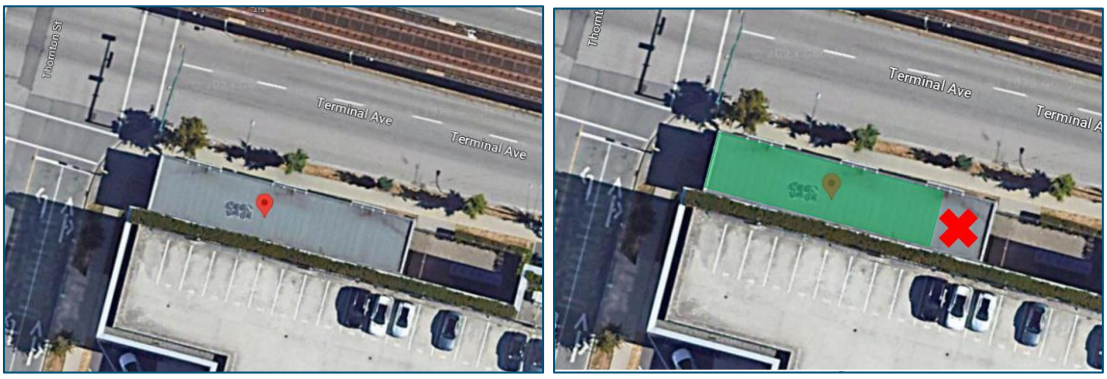
TransLink staff collaborated with BCRTC to identify a suitable infrastructure that can potentially benefit from the paint. The team focused to prove the practical application of the nano paint on its solar reflectance and thermal emittance capability.

The pilot was divided to two phases. The first phase was to test the solar reflectance of the paint or its ability to deflect heat and make the surface cooler. The second phase was to test its thermal emittance properties or the paint's ability to reduce the heat transfer into the building resulting to cooler interior.



Phase 1 (2023)

The first phase was tested in BCRTC's substation located at the corner of Thornton Street and terminal avenue in Vancouver, BC.



Roof Material: 2-ply SBS with granulated surface
Roof measurement: approximately 2,175 sq. ft.
Address: 540 Terminal Avenue Vancouver, BC
Gallons used: 12 gallons (CAD 517/gallon)
Cost per square ft: $2.85

The effectiveness of the paint was demonstrated using comparative temperature data of a surface that is covered by the Nano coating and a surface that is not. 80% of the building was covered with nano paint and the remaining 20% was left unpainted. This allowed a direct comparison to be made between the portion treated with the Nano material and untreated, under identical conditions.

The study measured the temperature of the roof over a period of 5 weeks. There were broad temperature recordings of the entire roof as well as spot recordings. The temperature data collected was used to display the temperature difference between the coated and non-coated parts of the roof to calculate the energy saved.

An independent 3rd party vendor was tapped to use thermal scanners on certain points of the day to measure effectiveness of the product. This enabled the team to gather data relating to the product's efficacy. The thermal readings provided temperature gradient data that allowed direct comparison between the coated and uncoated parts of the roof. With this temperature gradient data, the solar reflectance was compared to that from the Cool Roof Rating Council trials.

Including Outside Temp.	Nano coated	Uncoated	Difference
1st Reading (27.0 C)	54.8 C	58.9 C	**-4.1 C**
2nd Reading (26.3 C)	51.5 C	57.6 C	**-6.1 C**
3rd Reading (25.3 C)	45.7 C	50.4 C	**-4.7 C**
4th Reading (24.2 C)	*NA*	*NA*	*NA*
5th reading (22.1 C)	47.0 C	52.3 C	**-5.3 C**

The result showed at least 10% cooler than an untreated surface all things being equal.

Phase 2 (2024)

The second phase of the pilot focused on Thermal emittance or the ability to cool the interior of the building by deflecting the heat from the sun and preventing it from penetrating the surface. If successful, this can lead to improving occupant comfort and energy savings.

For this phase, the team identified an infrastructure that has sun exposure to test during the summer. The building that was selected is a substation under the Skytrain with no adjacent buildings beside. The location is in the Brunette-Fraser Regional Greenway in New Westminster between Sapperton and Columbia station.

Roof Material: 2-ply SBS with granulated surface
Roof measurement: approximately 2,580 sq. ft.
Wall Material: Clay Sediment (Brick)
Wall Measurement: 3,944 sq. ft.
Geographic coordinates: 49.2200650°N, 122.8923881°W
Gallons used: 35 gallons (CAD 265/gallon)
Cost per square ft: $1.41

Thermometers were installed inside and outside of the building. Temperature was tracked on an hourly basis before and after the paint was applied to measure effectiveness of the paint in cooling the interior of the building.

Figure 2: After nano paint application

Result of second phase

The result of the second phase was challenging because the project team could not compare the results side by side. Analyzing all the data points does not show considerable impact of the paint in terms of cooling the substation inside.

However, the effectiveness of the paint is displayed when the sun is shining thus majority of the data points taken when sun is not directly shining at the infrastructure will not show effect of the paint. Comparing July 10 and August 17 readings side by side one will notice that while the outside surface comparable the interior of the treated surface on August 17 is cooler by a few degrees. This can also be inferred on other days when the outside temperature is similar.

Lessons Learned and Recommendations

Application

- Surface preparation is critical. The effectiveness of nano paint relies heavily on proper surface preparation. Uneven or poorly prepared surface can result to compromised effectiveness of the nano paint and wastage of paint / requiring more paint.

- Estimates provided by manufacturer on amount of paint needed is severely understated. Provision for extra when creating a budget / business case.

Performance

- Consider winter heating penalty in application. During colder days, the surface will be absorbing less sunlight thus reducing heat conduction into the building thus increasing need for heating in winter.

- Carefully consider where to use nano paint. Due to its high thermal emittance properties, it can heat surrounding area where the nano paint is applied. It works well for protecting interior of building from heat, but the heat will dissipate in the surrounding area.

- The second phase yielded mixed results. Analyzing the data without removing the times when the sun is not shining showed a different result than analyzing the data when the sun is at its brightest. It could mean that to extract the full benefit of the paint, use it on areas exposed to sun the most and would benefit from decreased temperature.

Cost

- If the paint will be adopted in widespread usage, consider manufacturers in North America to minimize on cost. Cool Roof Rating Council publishes all certified paint manufacturers worldwide.

- Lack of government rebates in Metro Vancouver makes the paint expensive for purpose.

Next Steps and Targeted Opportunities

RECOMMENDATIONS

- The pilot confirmed the effectiveness of nano paint in solar reflectance and thermal emittance. However, the cost of the nano paint is almost 10x the cost of a regular paint. If this technology is considered for future infrastructure implementation, consider an in-depth cost benefit analysis as to where the paint will be applied and the potential savings that can be derived on that location because there will be areas where the cost of the product will outweigh the potential benefits it will serve the public.

- Other benefits of the paint can be explored further such as the prevention of graffiti and filtration of pollution. It can be used strategically on high traffic areas, vandalism prone or surfaces that are directly facing the sun.

- Explore comparable technology offered in North America. FN Nano is from Czechoslovakia. If the organization was to adopt this technology for widespread use looking for paint providers in North America and that are certified by Cool Roof Rating Council (CRRC) can help drive down the cost of adaption.

- Collaboration with Metro Vancouver and municipalities to investigate cool roof program for houses and commercial infrastructures combined with an effort to retrofit existing infrastructure to use nano paint can help make a concentrated

Appendix 1: Result of phase 1 thermal scan

Measurements

EI1	Max	58.9 °C
	Min	54.0 °C
EI2	Max	54.8 °C
	Min	50.7 °C

Parameters

Emissivity	0.95
Refl. temp.	-40 °C

Geolocation

Compass	76° E
Location	N 49° 16' 17.22", W 123° 5' 35.78"

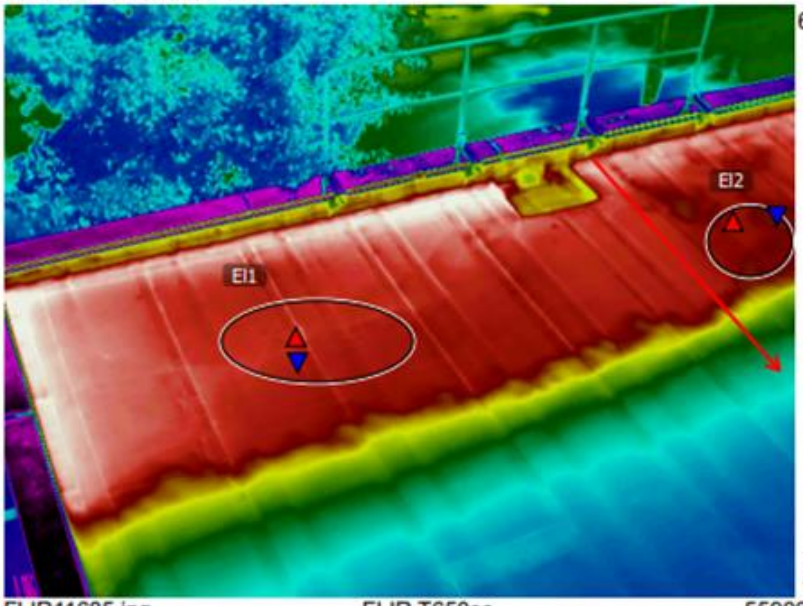
http://maps.google.com?z=17&t=k&q=49.2715,-123.093

Note

The first Images were taken at 11:51 am with an exterior Temperature of 27.0 degrees Celsius with 40.4% RH. Not all of the coatings were completed for this scan.

The read arrow is highlighting the divided area where the paint is applied and not applied to the roof surface.

2023-08-26 10:20:06 AM



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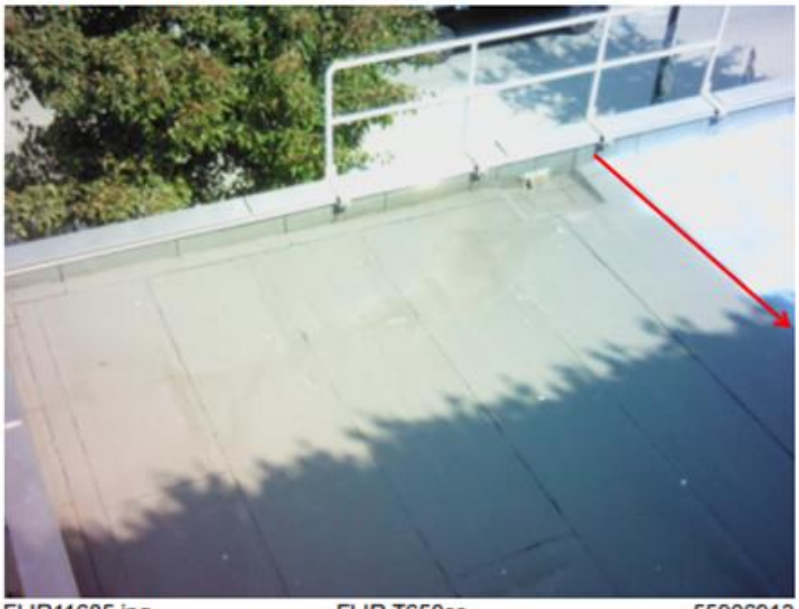


FLIR11685.jpg FLIR T650sc 55906913

Figure 3: 1st Reading

Measurements

EI1	Max	51.9 °C
	Min	45.1 °C
EI2	Max	52.4 °C
	Min	47.6 °C
EI3	Max	51.5 °C
	Min	42.5 °C

Parameters

Emissivity	0.95
Refl. temp.	-40 °C

Geolocation

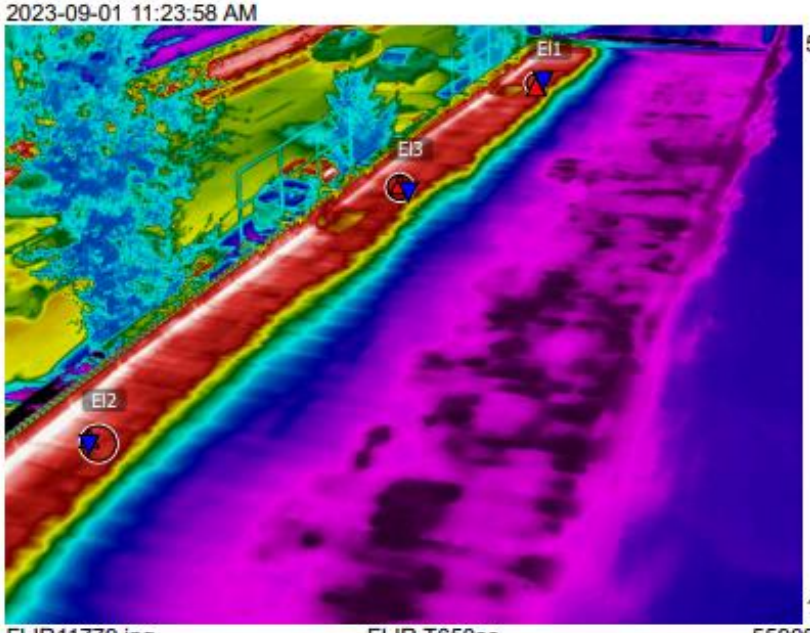
Compass	340° N
Location	N 49° 16' 17.64", W 123° 5' 35.49"

http://maps.google.com?z=17&t=k&q=49.2716,-123.093

Note

The Second Images were taken at 12:57 pm with an exterior Temperature of 26.3 degrees Celsius with 47.3% RH. The final coats were applied prior to the temperature scanning. The Rooftop area had some surface moisture at the time of scanning.

2023-09-01 11:23:58 AM



FLIR11779.jpg FLIR T650sc 55906913

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FLIR11779.jpg FLIR T650sc 55906913

Figure 4: 2nd Reading

Measurements

Bx1	Max	51.5 °C
	Min	48.0 °C
Bx2	Max	57.6 °C
	Min	53.6 °C

Parameters

Emissivity	0.95
Refl. temp.	-40 °C

Geolocation

Compass	296° NW
Location	N 49° 16' 17.68", W 123° 5' 35.53"

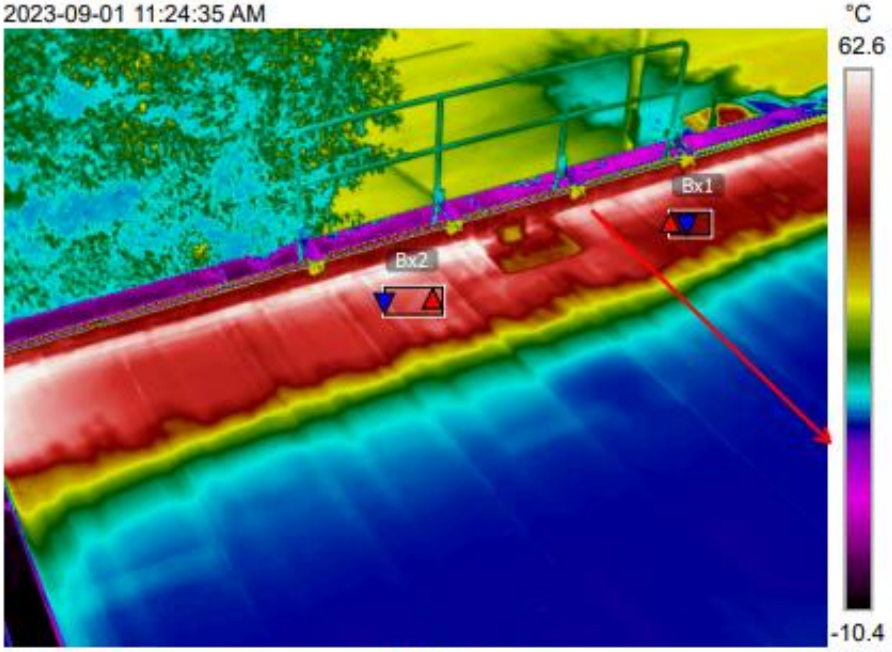
http://maps.google.com?z=17&t=k&q=49.2716,-123.093

Note

The Second Images were taken at 12:57 pm with an exterior Temperature of 26.3 degrees Celsius with 47.3% RH. The final coats were applied prior to the temperature scanning. The Rooftop area had some surface moisture at the time of scanning.

The read arrow is highlighting the divided area where the paint is applied and not applied to the roof surface.

2023-09-01 11:24:35 AM



FLIR11781.jpg FLIR T650sc 55906913

2023-09-01 11:24:35 AM

FLIR11781.jpg FLIR T650sc 55906913

Figure 5: 2nd Reading

Measurements

Bx1	Max	50.4 °C
	Min	46.3 °C
Bx2	Max	45.7 °C
	Min	42.8 °C

Parameters

Emissivity	0.95
Refl. temp.	-40 °C

Geolocation

Compass	315° NW
Location	N 49° 16' 17.40", W 123° 5' 35.76"

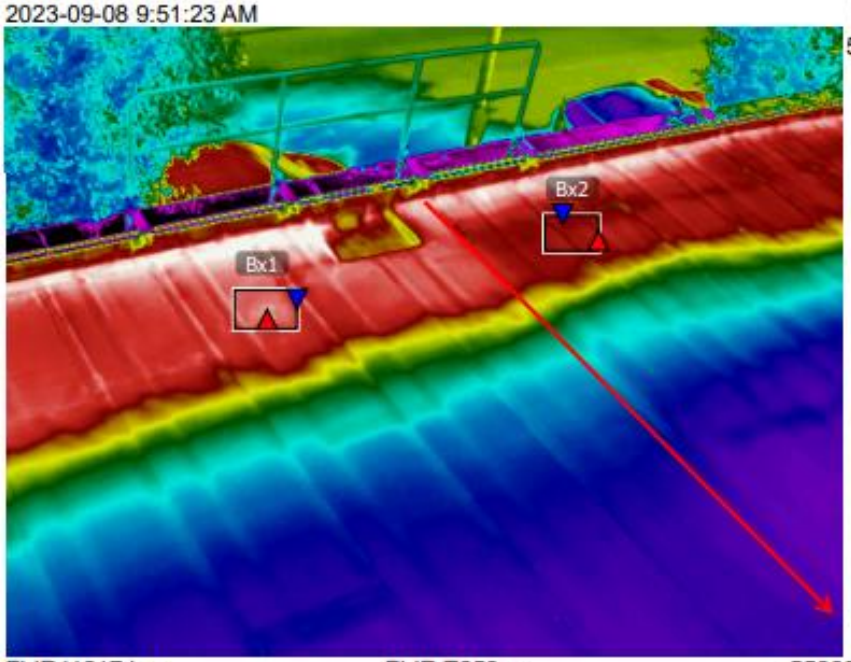
http://maps.google.com?z=17&t=k&q=49.2715,-123.093

Note

The Third Images were taken at 11:40 am with an exterior Temperature of 25.3 degrees Celsius with 49.8% RH.

The read arrow is highlighting the divided area where the paint is applied and not applied to the roof surface.

2023-09-08 9:51:23 AM



FLIR11817.jpg FLIR T650sc 55906913

2023-09-08 9:51:23 AM

FLIR11817.jpg FLIR T650sc 55906913

Figure 6: 3rd Reading

Measurements

EI1	Max	49.3 °C
	Min	46.1 °C
EI2	Max	45.9 °C
	Min	42.4 °C
EI3	Max	46.6 °C
	Min	41.8 °C

Parameters

Emissivity	0.95
Refl. temp.	-40 °C

Geolocation

Compass	307° NW
Location	N 49° 16' 17.31", W 123° 5' 35.74"

http://maps.google.com?z=17&t=k&q=49.2715,-123.093

Note

The Third Images were taken at 11:40 am with an exterior Temperature of 25.3 degrees Celsius with 49.8% RH.

The read arrow is highlighting the divided area where the paint is applied and not applied to the roof surface.

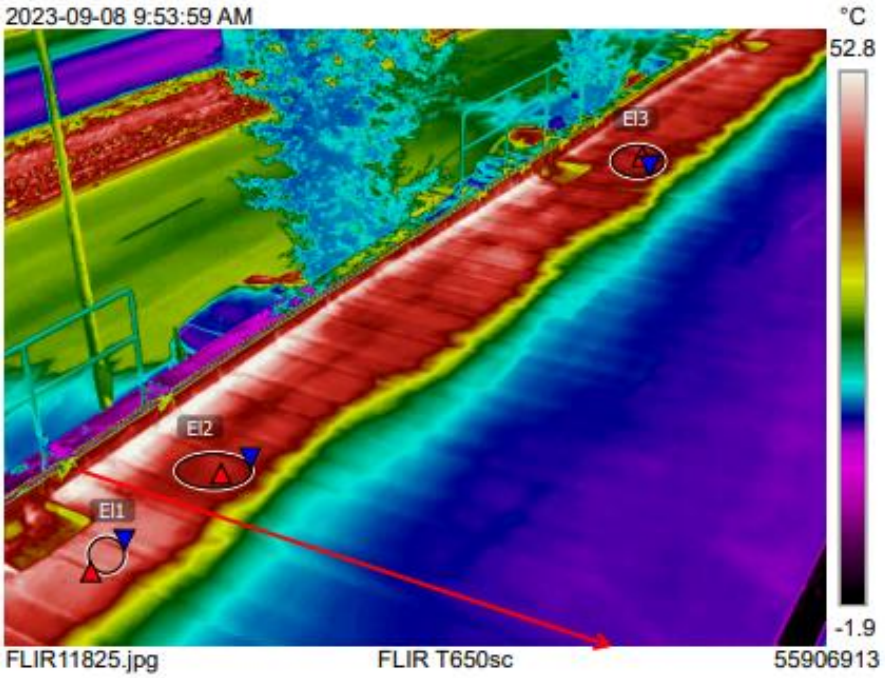


Figure 7: 3rd Reading

Measurements

EI1	Max	48.1 °C
	Min	43.0 °C
EI2	Max	49.3 °C
	Min	44.0 °C
EI3	Max	49.0 °C
	Min	42.5 °C

Parameters

Emissivity	0.95
Refl. temp.	-40 °C

Geolocation

Compass	326° NW
Location	N 49° 16' 17.15", W 123° 5' 35.67"

http://maps.google.com?z=17&t=k&q=49.2714,-123.093

Note

The fourth Images were taken at 12:01 pm with an exterior Temperature of 24.2 degrees Celsius with 52.2% RH.

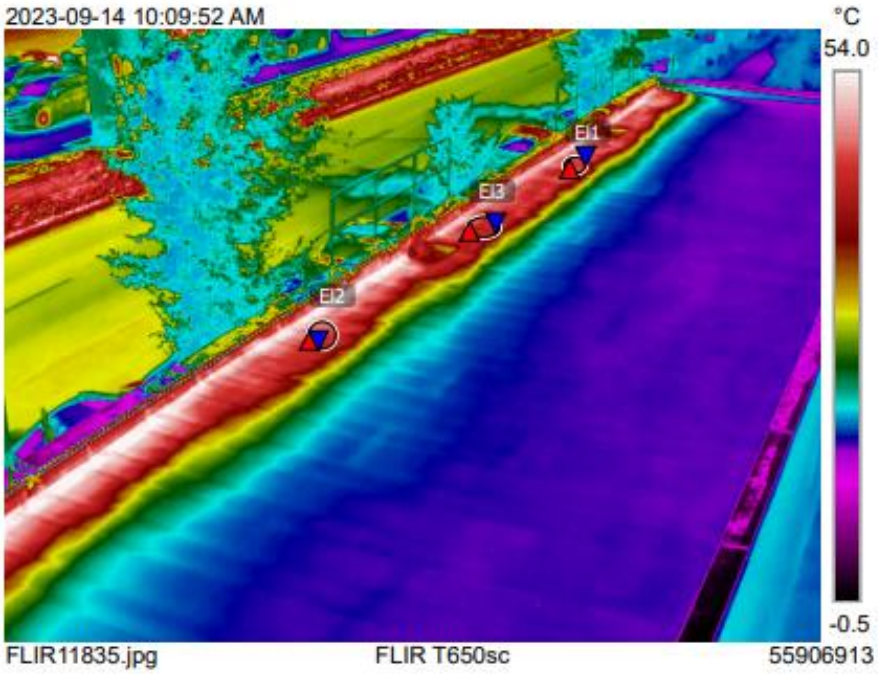


Figure 8: 4th Reading

Measurements

Bx1	Max	47.0 °C
	Min	34.8 °C
Bx2	Max	52.3 °C
	Min	40.8 °C

Parameters

Emissivity	0.95
Refl. temp.	-40 °C

Geolocation

Compass	316° NW

Note

The fifth Images were taken at 11:26 am with an exterior Temperature of 22.1 degrees Celsius with 47.8% RH.

The read arrow is highlighting the divided area where the paint is applied and not applied to the roof surface.

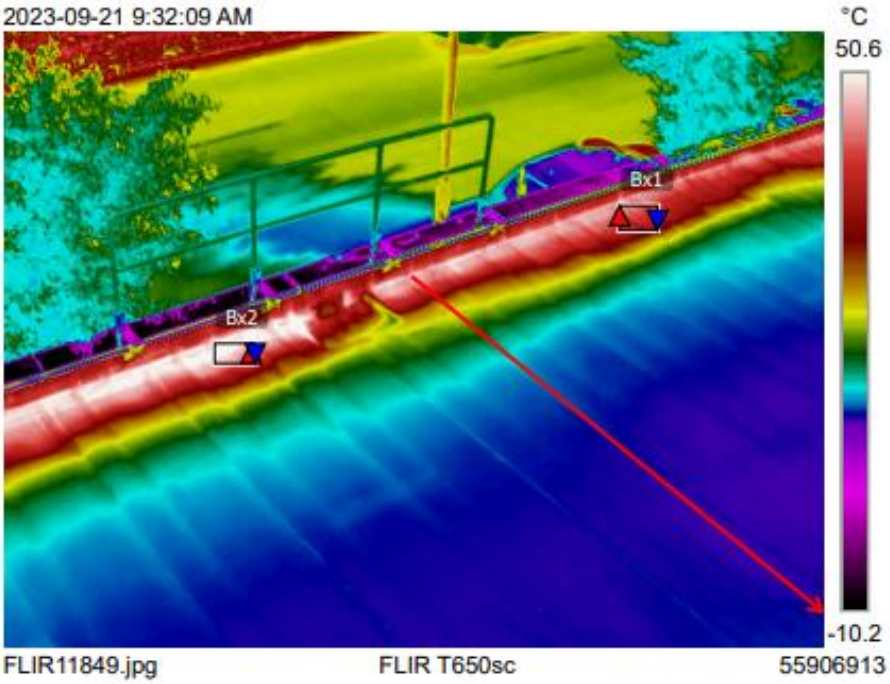


Figure 9: 5th Reading

Appendix 2

Document	
Scope of Work	Scope of Work - Nano Paint.pdf
Report from CHP	PILOT PROJECT FN NANO & TRANSLINK
FN Nano – Final assessment report	TRANSLINK - FN NANO PILOT PROJEC~
Phase 2 Temperature Measurement	FN Nano Study (Data).xlsx
FN Nano Certification	Certificate_ESG_FN-NANO Translink-fin.
FN Nano Final Report	Report_ESG_FN-NANO Translink.pdf