Final Report

CONCEPTUAL DESIGN STUDY

PEDESTRIAN OVERCROSSINGS

LAKE OTIS PARKWAY AND

NORTHERN LIGHTS BOULEVARD

MOA PM&E PROJECT NUMBERS 08-32 AND 12-35

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SUMMARY

The Municipality of Anchorage received a request to provide an "ADA" compliant (unobstructed) accessible route for the pedestrian overcrossings on Lake Otis Parkway at Lake Otis Elementary, and on Northern Lights Boulevard at Rogers Park Elementary. This report is a study of the existing bridge structures, the feasibility of providing new access ramps, and the implications of those new access ramps on the surrounding communities.

This study first reviews the bridges with regard to the applicable building codes for strength and serviceability. If the bridge structures are not compliant with these codes, they must be replaced or upgraded as part of the future project. This study found that the two bridges are significantly deficient with regard to current building codes; to the extent that they should be replaced rather than refurbished. The existing bridges do have value; they can be re-purposed to other uses as replacement structures for outdated bridges elsewhere on the bike trail system where they can be installed on shorter spans.

The communities cited appearance and safety as two of their main concerns regarding these new access ramp and bridge structures. With regard to the accessibility guidelines; this study finds that the accessible ramps must be over 100 yards long to elevate pedestrians to bridge level, and they must be covered to keep them free of snow and ice (unobstructed). The new structures must also be lighted for safety. The combination of the bridge and the two ramps of this length and height will become significant features in the Lake Otis and Rogers Park communities.

Creating accessible routes at both bridge sites is a costly undertaking. Each bridge spans approximately 100 feet. Each structure has a bridge deck and a roof, so effectively there is 200 lineal feet of elevated structure. The replacement structures will include the bridge spans plus approximately 700 feet of access ramp, which must also be covered to provide an unobstructed route. Effectively, each replacement structure will have approximately 1,600 lineal feet of elevated structure; eight times larger than the original structure. This incredible length of ramp structure will be challenging and costly to build relative to the existing buried and overhead utilities that surround each bridge site. Additionally, there will be significant operation costs associated with maintenance, and the cost of lighting each structure. The cost to build these structures is estimated to be $4.8 M for the Lake Otis crossing, and $5.1 M for the Rogers Park crossing.

The two communities may be better served, and the overall cost of these two projects can be significantly reduced, if the two bridge sites are considered components of a greater, area-wide shared-use trail system. The more cost effective solution appears to be to construct new, uncovered ramps and bridges to service the skiers, skaters, runners, bicyclists and other trail users. Providing new ramps, bridges and lighting will discourage at-grade road crossings making the trail system and the road system safe for all users. In addition to the other benefits, new bridge and ramp structures without roofs would reduce the project construction costs approximately 20 percent to $3.8 M and $4.0 M for Lake Otis and Rogers Park, respectively.

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ACRONYMS

AASHTO .....American Association of Highway and Transportation Officials
ADA.....American with Disabilities Act
IBC.....International Building Code
LED.....light-emitting diode
LRFD.....Load and Resistance Factor Design
MOA.....Municipality of Anchorage
PM&E.....Project Management and Engineering
UAA.....University of Alaska Anchorage
USKH.....USKH Inc.

1 PROJECT OVERVIEW

The students who attend Lake Otis Elementary and Rogers Park Elementary must cross major thoroughfares in mid-town Anchorage to get to and from their school each day. Bridges are provided over Lake Otis Parkway (Appendix A, Photo 1) and Northern Lights Boulevard (Appendix A, Photo 2) so the students may safely cross these busy streets. The project locations are shown in Figure 1 where Northern Lights Boulevard is along the top edge of the photo, and Lake Otis is on the right edge. The bridges were constructed in the late 1970s or the early 1980s in a time when little consideration was given for mobility-challenged persons. Access to each bridge is provided by a stair tower at each end of each bridge.

The two community councils in the area, Rogers Park and the University Area made a request to the Municipality of Anchorage (MOA) to upgrade the access to these two bridges so they are compliant with the Americans with Disabilities Act (ADA). This report is the findings for the initial studies for making these two bridges accessible to mobility-challenged people.

Figure 1 – Vicinity and Location Map

The scope of this study is three-fold. The first portion of this study is to evaluate the physical condition of each bridge, and to determine if the two bridge structures conform to current bridge design codes. The second portion of this study is to propose solutions for accessible routes to and from each bridge, and to evaluate the impacts of those solutions to the communities that the bridges serve. Last, the study is to prepare a rough order of magnitude cost for accomplishing the accessibility goal.

1.1 Background

The exact chronology of when the bridges were built is not known, and that information is not crucial to the focus of this report. USKH has copies of what appears to be as-built drawings for the bridge over Lake Otis Parkway at Lake Otis Elementary, but we were unable to find drawings for the Northern Lights Bridge. The bridge over Northern Lights Boulevard is very much the same as the Lake Otis Bridge. The bridges are both thru-truss timber bridges with a plywood roof and a concrete topping slab on the floor.

The bridge over Lake Otis spans 90 feet, the bridge over Northern Lights at Rogers Park spans 117 feet, about 30% longer than the Lake Otis Bridge. As a result, the timber elements that comprise the trusses at Rogers Park are larger than those comprising the Lake Otis Bridge, but the connection details all appear to be the same. The timber tower that supports the bridges appears to be the same, but the stair runs for each appear to be different.

The stair runs for the Lake Otis Bridge are straight as shown in Photo 1 and Photo 3. They begin at grade, up one run of stairs, a landing, another run of stairs to an upper landing at the bridge. The stairs at the bridge over Northern Lights Boulevard have a 180 degree turn at the intermediate landing as shown in Photo 2 and Photo 4.

As stated in the Project Overview, both bridges are designed to move pedestrians across major thoroughfares without installing traffic control devices. Each bridge, support towers and stairs are contained within the public right-of-way. The right-of-way for the bridge over Lake Otis Parkway was widened to encompass the bridge and supporting structure. The current footprint of the bridge cannot be altered without a land acquisition or a legal land use permit. The bridge over Northern Lights Boulevard is well within the limits of the right-of-way which permits any number of options for altering the bridge and/or support structures.

2 STRUCTURAL EVALUATION

The structural evaluation consists of mathematical calculations relating the structural loads to actual strength and serviceability of the bridge in a theoretical sense. The second portion of the structural evaluation is a visual inspection to determine if the individual elements are capable of delivering the strength or performance necessary to satisfy the analytical model. In other words, is each structural element capable of performing as the analytical model shows it must?

2.1 Applicable Codes

The bridges can be analyzed using either the American Association of Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications", or the 2009 International Building Code (IBC) code as adopted and amended by the MOA. Since this project is contracted by the MOA, the IBC 2009 was used for this analysis.

Both codes contain an accepted means of calculating the capacity of a bridge known as Load Resistance Factor Design (LRFD). Each design load is assigned a load factor that is an estimate of its reliability, or more appropriately its un-reliability. The less reliable a load is, the higher it load (safety) factor is. For example, the dead load of a structure can be calculated with reasonable accuracy, so its load factor is 1.2. The estimate of the wind load on a structure is much less reliable, so its load factor is 1.6. Both codes assign load factors to various loads and the sum of a combination of loads is then compared to an ultimate design strength for the material.

By way of comparison, the AASHTO method and the IBC use different loads and load factors. The AASHTO code tends to use somewhat lower allowable loads, but assigns higher load factors to the loads. The IBC users higher design loads and lower factors. The end result is the two code approaches produce approximately the same result. Either code can be used for the purposes of this study.

2.2 Applicable Material Properties

The basis of any structural design is to choose acceptable design loads, apply load factors to those loads (safety factors), calculate an internal stress in a structural element resulting from the load combination and compare that stress to an accepted limit for that material. The next question to be answered is, "What is an acceptable design limit for the material?"

To answer this question relative to this project one must review the history of timber design in the United States in the 20th Century. Early codes were developed based on stress testing of clear samples of various species of timber. During that same period, lumber and timber products were visually graded; a somewhat unreliable method for determining a piece of timber's design strength. In the 1960, the timber industry researched a method to more accurately predict the strength of individual pieces of wood by mechanically bending them in a machine. The research shows the allowable strength of wood in tension was overestimated in earlier codes.[1]

[1] Newman, Alexander, P.E. 2001. "Structural Renovation of Buildings, Methods, Details, and Design Examples", Section 8.1.6. New York, New York: McGraw-Hill.

Wood is a natural material full of defects including: knots, splits, shakes, holes from insects, and many other factors. The result for the mechanical testing in the late 70s shows that a full length sample of a timber or a board with all its imperfections is not as strong as the test on a sample free from defects might suggest. As a result of the testing, the tension design values for nearly every species of wood were decreased, some as much as 50%.

The implication of this bit of history for this project is that the tension design values listed in the general notes is suspect. Some of the new tension design values didn't get adopted into popular codes until the mid to late 80s. These two bridges were designed sometime in the mid-70s, well before the full impact of the stress grading was known in the timber industry.

To fully evaluate this bit of uncertainty in our calculations, USKH first evaluated the bridges using the design unit stresses show on the plans. We then went back and re-evaluated the bridges using what we believe are the correct allowable unit stresses.

2.3 Results of the Analytical Modeling

A bridge is subjected to a wide variety of loads which always act in combination with the other loads. The most simple design load is the bridge supporting its own weight, referred to as dead load. The next simplest case is the bridge supporting its own weight plus the weight of persons or objects on the bridge. Transient loads like people or objects are call live loads. Other forms of live loads are environmental loads like the weight of the snow on the roof, the wind blowing against the bridge, or earthquake loads. The structural analysis considers the most likely combination of loads to act on a structure during its intended life such as the dead load plus the floor live load plus the full roof snow load.

The structural calculations determine the forces acting internally on each structural element given the combination of loads acting externally on the structure. The engineer then calculates the capacity of each structural element in the bridge based on the properties of the material and the conditions under which the element is attached to the other components in the bridge. If the demand placed on an element from the external loads exceeds its structural capacity, the element is deficient.

In reality, engineers design structural elements with a factor of safety. Each element should have a capacity 50% greater than any load combination it is expected to carry. So, when an element is deficient, it generally implies that the element fails to meet the requirements for 'safe design' as defined by the code. A deficient element is not necessarily one that breaks; it should still have approximately 50% reserve strength. A structure becomes unsafe when the external loads create a level of stress in excess of 150% of an element's capacity, meaning the element is on the verge of breaking.

The results of USKH's structural calculations are presented in the two tables below. These tables represent the maximum anticipated stresses in various structural elements as a percentage of their code design capacity. More simply stated, a stress of 100% represents an element stressed to its code design limit, a stress of approximately 150% is an element stressed to the point of being unsafe.

Table 1 – The Roger's Park Bridge

Structural Element	Design Limits Listed on Drawings	Design Limits Posed by Current Code	Failure Mode
Top Chord	183%	223%	Compression + Bending
Bottom Chord	<100%	111%	Tension
Web	102%	117%	Compression
Floor Joist	140%	-	Bending

Table 2 - The Lake Otis Bridge

Structural Element	Design Limits Listed on Drawings	Design Limits Posed by Current Code	Failure Mode
Top Chord	107%	130%	Compression + Bending
Bottom Chord	<100%	101%	Tension
Web	<100%	<100%	Compression
Floor Joist	140%	-	Bending

The tables above indicate that some of the structural elements are stressed beyond what is considered a safe limit. The logical question is, "How can that be?" The answer is the stresses above are at maximum statutory load combinations, and not at load levels the bridge is likely to actually experience. The structural calculations require the bridge be analyzed for its full dead load, the full floor load plus the full roof design snow load.

Rarely does Anchorage ever receive a full design snow load in any one year. Even then, the bridge is cold, so some of the snow could blow off; some could melt, so having a full design roof snow load is unlikely. Similarly, it is very unlikely that the bridge will ever experience a full design floor load. A full design floor load for the bridge is approximately 1,000 sixth-grade students all on the bridge simultaneously. The probability of these two events happening at the same time is extremely small. Hence, the bridges still exist even though they are deemed deficient with regard to the code.

To summarize, both the Lake Otis and the Rogers Park bridges are deficient under full gravity loads. The bridge truss top chords fail under the combined effect of full snow load and full floor load. The slender webs are deficient for the longer Rogers Park Bridge.

2.4 Lateral Load Analysis

Both bridges rely on horizontal plywood diaphragms at the roof and floor level to resist seismic and wind loads. These diaphragms are not specifically detailed for seismic resistance, they are not blocked at all panel edges, nor is there sufficient nailing between at the plywood panel edges to transfer the required lateral loads to the support towers. Both bridges are deficient with regard to seismic resistance.

The support towers resist lateral loads using coupled columns. The intent appears to have been to resist lateral forces by creating a moment resisting frame using the columns and short, but deep coupling beams. This type of framing system was proven to be very susceptible to seismic loads during the 1964 earthquake in Anchorage, as demonstrated in the McKay Building. The short, deep beams are subjected to very high shear loads. In the case of these two bridges, the shear is applied parallel to grain, a loading direction for which wood is known to be very weak. In their present conditions, the bridges are not capable of resisting code-level seismic design forces without significant damage.

2.5 Physical Condition

The next consideration after the analytical review is whether the individual structural elements are capable of developing their full design potential given their physical condition. A site inspection of the bridges was completed in November and December of 2013. USKH discovered that the timbers in both bridge structures are in very good condition given their age. However, some of the other components of the bridge and supporting towers are not.

The timber framing for the bridges and the support towers was preservative treated with what appears to be creosote. Coal-tar and oil-tar creosotes have long been used as preservatives for wood, but are no longer permitted to be used where they can come into contact with humans or animals. Creosote is known to be toxic and a carcinogenic compound.

The entire length of each bridge is lined with chain-link fencing to prevent items being dropped on the cars below. A side benefit of the chain-link is that it prevents anyone using the bridge from contacting the treated wood members. Significant portions of the stair towers are also lined with chain link, but not all. Making contact with the treated wood is possible on the stair of both bridges.

Whether fortunate, or unfortunate, the creosote covering the timbers in the supporting towers and stair framing has been worn away by its exposure to the weather as can be seen in Photo 3 and Photo 4. This minimizes the hazard of a pedestrian getting a chemical burn from contact with the creosote as there is very little exposed now. The unfortunate side of this is that the wood is not well protected from the elements any longer.

The top chords of the trusses are well protected by the roof structure as shown in Photo 4. The truss webs and the bottom chords are not. These elements show significant raised grain on the weathered surfaces. The truss chords and webs are in very good condition other than the surface weathers, so they can be expected to achieve their full design strength.

The wood elements that form the support towers and the stair runs are not as protected so they show signs of more advanced weathering. Most of the support columns are badly checked or split, especially near the bases as shown in Photo 5 and Photo 6. Additionally, years of accumulated road sand have buried the bottoms of the columns. This sand holds moisture against the wood, increasing the potential for decay on the insides of the columns. None of the columns were cored to determine if they were decayed on the inside.

One item of significance is that the roofs of these structures have not been maintained as can be seen in Photo 9. As a result, the roofs leak allowing rain water and snow melt to reach the treated timbers as is evidenced in Photo 7 and Photo 10. Where once the timbers were preservative treated and protected from the elements,

they are no longer. The structures are beginning to show signs of degrading from their exposure. In particular, the column bases are beginning to check and split.

The leaks in the roof also make the condition of the roof framing suspect as well. There are numerous locations that show water stains on the plywood ceiling of both bridges, and a few small spots where the ceiling plywood is decayed, see Photo 8. The as-built drawings do not indicate that the roof joists are preservative treated, so they may be partially decayed where the roof leaks.

The stairs on both bridge structures are badly damaged from their exposure to the weather; see Photo 11 and Photo 12. The concrete infill on most of the stair treads for both runs of stairs on the Lake Otis site is so badly weathered that it was over-framed with GripStrut metal stair treads as shown in Photo 12. This over-framing was likely added to reduce the possibility of slipping on the wet, or iced concrete stairs. Although the concrete infill on the Rogers Park Bridge is still in good condition, the metal pans supporting the concrete are badly corroded.

The plywood floor in both bridges is in poor condition (Photo 13) as a result of water infiltration. The roof does little to prevent precipitation from falling on the floors. The water then migrates down through the structure and soaks into the plywood. The actual condition of the plywood is unknown because it is inaccessible except from a lift on the road. The water stains and the discoloration suggest that the plywood is in very poor condition.

Section 2.4 discussed the unconventional lateral force resisting system in the support towers. Whether due to exposure to the weather, or to earthquakes or wind loads, one of the horizontal coupling beams between the support columns is cracked at mid-height as shown in Photo 14. The crack is difficult to see; look to the left end of the horizontal beam where it is most apparent.

The last item of note is that two of the pile caps at the west end of the Lake Otis Bridge are badly cracked as shown in Photo 15 and Photo 16. The concrete pile cap is the mechanism that attaches the wood structure to the steel pile foundation. Obviously the pile cap is still working to transfer gravity loads from the structure to the pile foundation, but its capacity to resist uplift loads generated by lateral loads (wind or seismic) is unknown at this time. It is safe to say the pile cap is in need of repair.

2.6 Summary

In summary, the bridges both fail an analytical analysis regardless whether the analysis is based on the unit stresses listed on the drawings or on unit stresses permitted in the current code. If the existing bridge portions of the structures are intended to be reused, they both must be retrofitted to bring them into conformance with current design standards. The repairs needed include:

- Removing and replacing the existing roof, remove/replace plywood as needed.
- Re-nail roof plywood as part of the re-roofing project
- Removing the concrete floor topping, replacing floor plywood as needed, replace floor topping.
- Strengthening floor joists
- Augmenting the truss top and bottom chords
- Creating a well-defined load path for lateral loads from the ends of the bridge down to the foundations
- Pressure inject the cracks and splits in the timber columns

- Re-apply a new wood preservative (surface treatment) to the timbers
- Remove and replace all the stair treads

The list of items to be repaired or renovated essentially is re-vamping the entire bridge.

2.7 Discussion of Structural Remediation

The list of modifications necessary to make the existing bridges compliant with the structural provisions of the current building code is rather extensive. The project goals may better be achieve by removing the existing structures and building new bridges with new approaches. The preceding discussion regarding analytical deficiencies and the present state of disrepair of many structural components is without regard to the future requirements of an ADA accessible bridge. Providing and accessible route across both highways means that the route will require a greater level of maintenance with regard to winter snow removal.

Providing an accessible route requires snow removal equipment must operate on the bridge. Even with a roof, the snow drifts in under the roof to cover the bridge deck and the stairs. As the present bridges stand, snow removal from the decks will impose a hazard to the traffic below the bridge. Snow and debris can fall through the existing chain link fence to rain down on the roadway below. To truly be classified as an accessible route, the route must be fully enclosed or otherwise protected (thermally) to prevent any snow or ice accumulation. Trying to retrofit the existing bridges with the necessary provisions is cost prohibitive.

Suggesting that the existing bridges be replaced is not implying that the existing bridges are without value. The timber bridge structures could be removed and repurposed as replacement structures for bridges on the bike trail system for example. USKH has performed other studies of the bridges on various bike trails in Anchorage. Those studies have identified several structures that are deficient or needing replacement. The two bridges that are the subject of this report can be modified and placed into service in other areas of the city.

2.8 Conclusions

The existing bridges and their supporting structures are not adequate to meet the goal of ADA compliant routes for Lake Otis Elementary and for Rogers Park Elementary. The bridges are structurally deficient in their present condition. USKH recommends the existing bridges be removed and replaced with new structures to achieve this project's goal. In addition to the structural considerations, there are many other factors to be discussed in Section 4 that further justify replacing these two bridge structures.

The bridges can be refurbished and put back into use, however they cannot be expected to last more than about 20 years. The cost of repairing each bridge structure will be approximately 30% of the cost of a new bridge. USKH strongly recommends installing a new bridge when the ramp structures are constructed instead of reusing the existing.

3 SPACE, AESTHETICS AND OTHER GENERAL DESIGN ISSUES

3.1 Compliance with ADA Requirements

Replacement of the overcrossing structures near Lake Otis Elementary and Northern Lights Elementary will require a major departure from the design of the current structures. The existing bridges are wood and steel structures with access to the bridges provided by wood stairs with no ramp. The current structures do not comply with current accessibility standards in effect in the United States, or current building codes in effect within the MOA.

The Americans with Disabilities Accessibility Act (ADA) was enacted by Congress in 1990. This legislation was developed to provide barrier free routes in buildings and other similar constructed facilities. The original legislation had been expanded to include a number of design guidelines for buildings, outdoor recreation access, trails, and shared use paths. The original standard was developed primarily for building type structures and not intended for an accessible route. In 2013, the United States Access Board published a new guideline for streets and sidewalks, specifically "pedestrian access routes." An accessible route is defined as a continuous, unobstructed path that connects all elements of a facility; the key word being "unobstructed." The two bridges in this report have been analyzed as a "pedestrian access route" to be consistent with the original request for an accessible route. The goal of a pedestrian access route is to create barrier free access for people using mobility devices like manual or motorized wheelchairs. The accessibility standards define a pedestrian access route as:

***"Pedestrian Access Routes**—A pedestrian access route, often called a sidewalk, is located in a public right-of-way and typically is parallel to a roadway. Consequently, sidewalk grades (running slopes) must generally be consistent with roadway grades so that they fit into the right-of-way. Sidewalks are designed for pedestrian transportation and are not designed for bicycles or other recreational purposes."*

To be considered "accessible" ramps must have a gradient less than 5%, a minimum width of 48 inches, and no vertical offset more than 1/4 inch. Ramps are more than 30 inches above an adjacent grade, they must have guardrails at least 42 inches high guardrails. The bridges must be a minimum of 19 feet (minimum clearance over the road of 18 feet plus 1 foot for structure) above the sidewalk elevation to assure clearance above traffic on Lake Otis Parkway and Northern Lights Boulevard. As a result, these ramps will have to be in excess of 350 feet long to achieve the 5 percent ramp grades required by ADA guidelines.

These requirements result in a very large ramp structures that will create greater visual and physical impact on the streetscape than the existing bridges and stairs have in both locations. Further, since existing right-of-way should be used to the maximum degree possible in order to minimize additional right-of-way acquisition costs, the structure will have to be situated very close to the roadway, creating a structure that will be visible for a significant driving distance.

To be truly accessible, the ramps must be kept free and clear of snow and ice. Compliance with requirement means the ramps must be fully enclosed (roofed) and/or provided with a snow melt system. Making a fully enclosed ramp structure would further increase the visual significance of this feature with regard to the roadway and it would have a significant visual impact on the community.

An alternate solution is available that reduces the visual impact of the new structures, reduces the construction cost; and, USKH believes, provides a solution that better serves the communities' needs. The alternate solution

is to consider the bridges part of a "shared-use path" instead of a pedestrian access route. A shared-use path is defined as:

***"Shared-Use Paths**—A shared-use path is part of a transportation system in a public right-of-way that provides off-road routes for a variety of users. Even where the primary users may be bicyclists, skaters, or equestrians, shared-use paths typically are designed to serve pedestrians, including people using mobility devices such as manual or motorized wheelchairs. In addition to transportation uses, shared-use paths often provide recreational experiences. They may extend or complement a roadway network. For example, they may supplement on-road bike lanes, shared roadways, bike boulevards, and paved shoulders. Shared-use path design is similar to roadway design but on a smaller scale and for lower speeds. Whether located within a highway right-of-way, provided along a riverbank, or established over natural terrain within an independent right-of-way, shared-use paths differ from sidewalks and trails in that they are designed for a variety of users and serve both recreational and transportation purposes."*

The ramps and bridges will be part of an area-wide shared-use path system that is not maintained during the winter for barrier-free access. Persons that rely on mobility assisted devices are not able to use the trail system to access the ramps and bridges, so providing a barrier-free ramp and bridge system as a component of a trail system that has limited maintenance during the winter months is hard to defend. Additionally, the Anchorage School District provides free transportation for mobility challenged people, so the request for a barrier-free crossing is even more difficult to justify.

USKH believes that the two communities would be better served if the new structures are not covered. Other trail users such as skiers, skaters, or bicyclists would no longer have to remove their skis, skates, or to dismount bikes to climb stairs to get to the bridge. Basic human nature is to take the path of least resistance which, at present, is an at-grade road crossing. Mobility-challenged people can use the overcrossings in the winter when the trail conditions are favorable, and the remainder of the trail users will have greater ease of access throughout the year, so they will be more likely to use the bridge if the ramps are installed.

The design drawings attached to this report show a solid roof structure over the bridge consistent with the original project request. The roof profiles could be slightly pitched, vaulted, or flat depending on the desired appearance of the structure. Flat or vaulted forms are implied in the design sketches.

Constructing new ramps and bridges without roof structures would reduce the total construction cost by approximately 20 percent. At first glance, it seems there should be a greater savings given the roof and the bridge deck are very similar in construction; removing the roof should yield a 50 percent savings in cost. In reality, the structure consists of the roof, the bridge deck, and the foundation system, so the roof is approximately 30 percent of the structure. The cost savings is further reduced because there is still a need to provide a protective fencing enclosure on the bridge over the travelled way to prevent objects from being dropped or thrown from the bridges. The protective fencing also allows pedestrians to remain visible and reduce the potential for crimes of opportunity. So, building ramps and bridges without roof structures does offer a significant savings, but it is not a 50 percent reduction in cost as one might expect.

3.2 Site-Specific Design Issues

3.2.1 Lake Otis Parkway Bridge

The Lake Otis Bridge, serving Lake Otis Elementary School, presents some design constraints due to the limited available right-of-way and the land uses on either side of the street. Lake Otis Elementary School is located on the east side of the street and Saint Mark's Lutheran Church is on the west.

The ramp on the east side school site has the least number of constraints that need to be satisfied. First, the lack of space in the right-of-way can be satisfied by an intergovernmental use permit. The ramp for the school side could be compact, with three switchbacks adjacent to the right-of-way; or, it could be extended to bridge over the school bus drop-off lane and terminate on school grounds near a school entry. Thus the east side has some flexibility on how best to meet requirements.

A west side church parking lot abuts the right-of-way along the west side of the Lake Otis Boulevard and extends the length of the block to the north from the present bridge site. Further, the width of the roadway and the need to fit multi-purpose trails within the right-of-way provides further constraints. The remaining right-of-way allows little room for anything other than a straight ramp profile.

The conceptual plans included in Appendix B show several ramp configurations that were considered as part of the initial design process. The current location of the bridge appears to be the optimum place for a replacement bridge given the physical constraints of the right-of-way on the west side of the street.

The west side presents more constraints however, due to the location of parking and church facilities. The bridge-ramp configuration that works best would provide a straight access ramp sloping to the north for a length of 350 feet.

The straight west side ramp would extend almost the entire length of the block between Duke Drive and Cornell Court, terminating approximately 40 feet from the corner at Cornell Court. This ramp configuration will have a major visual impact on the church property as seen from Lake Otis Parkway. Unfortunately, any configuration other than a straight ramp would require acquisition of additional right-of-way, or easements on the church property.

3.2.2 Northern Lights Boulevard Bridge

The location of the pedestrian bridge that crosses Northern Lights Boulevard near Rogers Park Elementary has fewer constraints than the Lake Otis Bridge location. The current location of the bridge appears to be the optimum location for a replacement bridge due to the geometry of both the street and right-of-way in that section of Northern Lights Boulevard. The existing median in Northern Lights Boulevard allows more flexibility in the bridge design, and the right-of-way at this location is much wider and allows several different ramp configurations. The plan view drawings in Appendix B show the various ramp configurations that were explored. The ramps with switchback configurations have less of an impact on the adjacent landscape and present less of a visual impact to the streetscape on either side of the street since the mass of the structure is less apparent from key view locations. Due to the width of the right-of-way, landscape plantings could be added to the plan to soften the ramp architecture and add interest to the streetscape.

3.3 General Design Elements

The deign sketches included in Appendix B show several design themes that were explored during the design phase. To a certain degree, the structural requirements for the bridges dictate the form of the bridges, as does the need to provide for the safety and security of bridge users. The railings and enclosures should be as transparent as possible to allow visual access to and from the ramps and bridges. For the most part, the bridge and ramp construction would be composed of painted or galvanized steel members. Thus opportunities to improve bridge aesthetics reside in the use of the exterior of the bridges as places for sculpture or other art pieces, or other ornamentation such as those shown in the design sketches.

The ramp structures should be designed to have as few foundations as possible, which translates into fewer conflicts with existing underground utilities and fewer obstructions at ground level, which improves pedestrian safety. Crimes of opportunity are less likely to happen when everything is in full public view.

3.3.1 Lighting

The bridges shown in the design sketches could be lighted using light-emitting diode (LED) fixtures to enhance user safety. Colored lighting could be used to highlight various design elements or art, or could provide serve as art in and of itself. Computer controlled LED lighting could add interest to the bridge ornamentation with shapes, forms, and movement. An example would be a Northern Lights theme where changing light colors and pattern would add interest to the sculptural elements. Artistic panels suspended from the roof structural elements could be used to add interesting light patterns to the bridge as well.

3.3.2 Themes

Themes should be used to add interest to the pedestrian bridges. Each bridge could have a unique theme or the two could be similar. Examples of themes for both bridges are included in Appendix B. Following are suggested possibilities:

- Northern Lights Theme – Various types and patterns of wavy, perforated metal panels (ribbons) back lit with northern lights colors to accent this theme. This could be added on both the bridge and ramp rails. Computer controlled LED lighting and ribbon patterns would emphasize movement typical of a northern lights' night sky.
- Anchorage Theme – Silhouettes of various species of trees and wildlife found in the Anchorage Bowl such as bull moose and black spruce. Contrasting colors could be used to de-emphasize the bridge and highlight the offset silhouettes.
- Animal Theme – Bears or moose-silhouettes of adults and young animals offset from the bridge frame using colors and possibly lighting to provide contrast and interest to the bridge and ramps.
- Merrill Field – Super Cub with Chugach Range silhouette- this composition could be highlighted by lighting on an airplane, a wind driven propeller, as well as ribbon lighting at the ridge of the mountain silhouettes to simulate alpenglow or sunrise.
- Architectural – Bridges with geometric patterns overlaid on the structure of the bridge to add interest. Another option would be to highlight the structural bridge elements or embellish them with a large arch or triangular shaped element. Geometric patterns could be offset at various distances and emphasized by back lighting the shapes at night during winter months.

3.3.3 Expected Use

The MOA provided pedestrian crossing data that was collected between January 17 and January 28, 2014. For that twelve-day period, the average crossings per day for the bridges were very similar: 57 crossings per day for the Lake Otis Bridge, and 60 crossings per day for the Northern Lights Bridge.

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4 AESTHETICS, SAFETY AND COMMUNITY IMPACT

Providing and ADA accessible route over Lake Otis Parkway and over Northern Lights Boulevard will have a significant impact on the adjacent communities and on the roads. USKH presented the Conceptual Design graphics in Appendix B to the public during an open house at Rogers Park Elementary School to solicit public comments. Although the specific comments varied slightly, they seemed to focus on common elements.

Several public comments mention the need for safety. Area lighting, lighting on the walkway, and generally open vistas are important features to enhance the safety of the users. Lighting for improved safety was more important than lighting for artistic or aesthetic reasons. Others mentioned the need to minimize the structure to lessen the visual impact.

One comment suggested moving the bridge over Lake Otis Parkway either north to service Wendler High School students, or south to better service University of Alaska Anchorage.

Other comments focused on the bridges' appearances. Many people favored dressing the bridges with graphic appliques to enhance their appearance, other comments noted that they wished to see an enhanced structural design that is not hidden behind the appliques. One comment in particular mentioned not liking the airplane graphic.

Other suggestions included:

- Pet friendly walking surfaces
- Accessible for bikes and/or skiing
- No more tree removal along the Northern Lights corridor
- Reduce the likelihood the structures will be re-decorated with graffiti

The overwhelming consensus is that the safety of the pedestrians and the drivers is THE paramount concern.

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5 COST

USKH prepared rough order of magnitude cost estimate for each bridge location. Each cost estimate is for structures with roofs consistent with the original scoping document. This estimate is referred to as the "base estimate." The estimated costs for other scenarios is determined by adjusting the base estimate.

The base estimate is based on current pricing information available on the MOA website and the scope is determined by the conceptual designs presented in Appendix B. Our estimate is based on a high unit cost for the bridge to account for the roof assembly and some limited art appliques. Each estimate includes fees for the design portion of the project (for design work, for preparing construction documents, and for construction administration fees), and for construction. We did not include any project management fees for MOA Project Management and Engineering (PM&E).

This report presents only a conceptual design so our construction cost estimate includes a 30 percent contingency fee that includes inflation for three years and an additional 15 percent to cover unknown items that will arise during the design period.

The base estimated cost for the Lake Otis Bridge is $4,880,000, and the estimate for the Northern Lights Bridge is $5,050,000. The cost difference for the two sites is not indicative of the Rogers Park Bridge being 30 percent longer than the Northern Lights Bridge. The unit cost for the Northern Lights Bridge is higher than the Rogers Park Bridge to account for some increased difficulty in the site work: both utility work, and right-of-way procurement.

Another scenario for accomplishing these projects is to re-use the existing bridges instead of installing new bridge spans. Refurbishing each bridge is probably best accomplished by removing the bridge span and placing it alongside the road as the repairs are made, and the ramps constructed. The estimated cost for constructing new ramps and re-using the existing bridge spans is $4.2 M for the Northern Lights Bridge, and $4.6 M for the Rogers Park Bridge.

The last scenario is to construct new ramps and bridges without roof structures. The bridges will require some form of fencing, but nothing as structurally sound as a roof structure might be. The estimated cost for the Lake Otis Bridge is $3.8 M, and the estimate for the Northern Lights Bridge is $4.0 M.

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6 CONCLUSIONS

Providing an ADA compliant route over Lake Otis and Northern Lights Boulevard is feasible and it has significant impacts to the communities surrounding the bridge sites. The larger question that must be addressed is how these bridges relate to a barrier-free access route within the community.

The primary function for each bridge is to move students safely between their homes and schools when they are located on the opposite sides of a major thoroughfare. The bridges are therefore used most during the winter. In the larger picture, “How will those most in need of a barrier free route travel to or from the bridge sites?”

Could the real intent be to provide a means for those who use the trails for bicycling, skiing, roller blades or other modes of transportation to move safely from one side of the highway to the other without crossing at grade? The geometry of the ramps would remain the same if the bridge is designed to service mobility-challenged users, or multi-use trail users. What does change and has a significant impact on this project is the need to prevent snow accumulation on the trails. Snow is a barrier to mobility-challenged users, but it can be considered a desirable feature for the multi-use trail group. This one question must be answered before this accessibility project can advance to the design phase.

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Appendix A –
Photographs

Photo 1 The bridge spanning Lake Otis Parkway.

Photo 2 The longer Rogers Park Bridge spanning Northern Lights Boulevard.

Photo 3 A view of the Lake Otis Bridge that shows how the stairs make a single run. This view also shows how the creosote has been worn from the surface of the timbers.

Photo 4 The Rogers Park Bridge. Note the weathered appearance of the wood.

Photo 5 The base of a timber column at the Rogers Park Bridge. Note the cracks at the base.

Photo 6 More views of the column bases at the Rogers Park Bridge.

Photo 7 Note the weathered appearance of the beam under the floor assembly and the water stain at the left end. Also note the damage to the beam behind and below the silver-grey beam.

Photo 8 A spot on the ceiling of the Rogers Park Bridge that has decayed.

Photo 9 The roof of the south stair at the Rogers Park Bridge. Note the missing shingles and the poor condition of the remaining shingles.

Photo 10 Here, a timber exposed to repeated wetting/drying cycles as a result of leaks in the roof.

Photo 11 One of the stair treads on the south end of the Rogers Park Bridge. Notice the heavy corrosion between the metal stair pan and the supporting angle.

Photo 12 A typical stair tread on the Lake Otis Bridge. The *gravel* is what remains of the concrete infill in the stair tread.

Photo 13 The underside of the floor deck at the Rogers Park Bridge. The floor joist connectors are badly corroded, and the plywood floor deck is weathered and/or decayed.

Photo 14 One of the coupling beams at the Lake Otis site. Of Note is the horizontal split at the mid-height of the beam across the entire length of the beam.

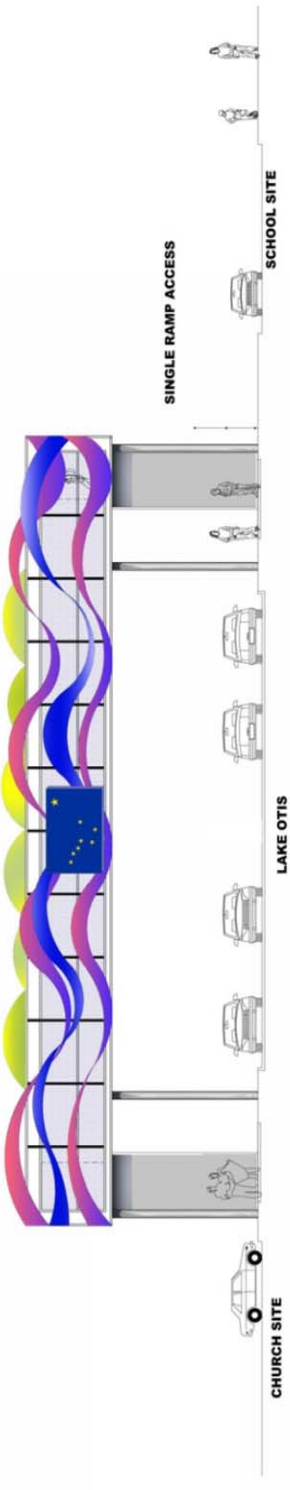
Photo 15 One of the cracked pile caps at the west end of the Lake Otis Bridge.

Photo 16 Another badly cracked pile cap at the Lake Otis site.

Appendix B –
Conceptual Plans

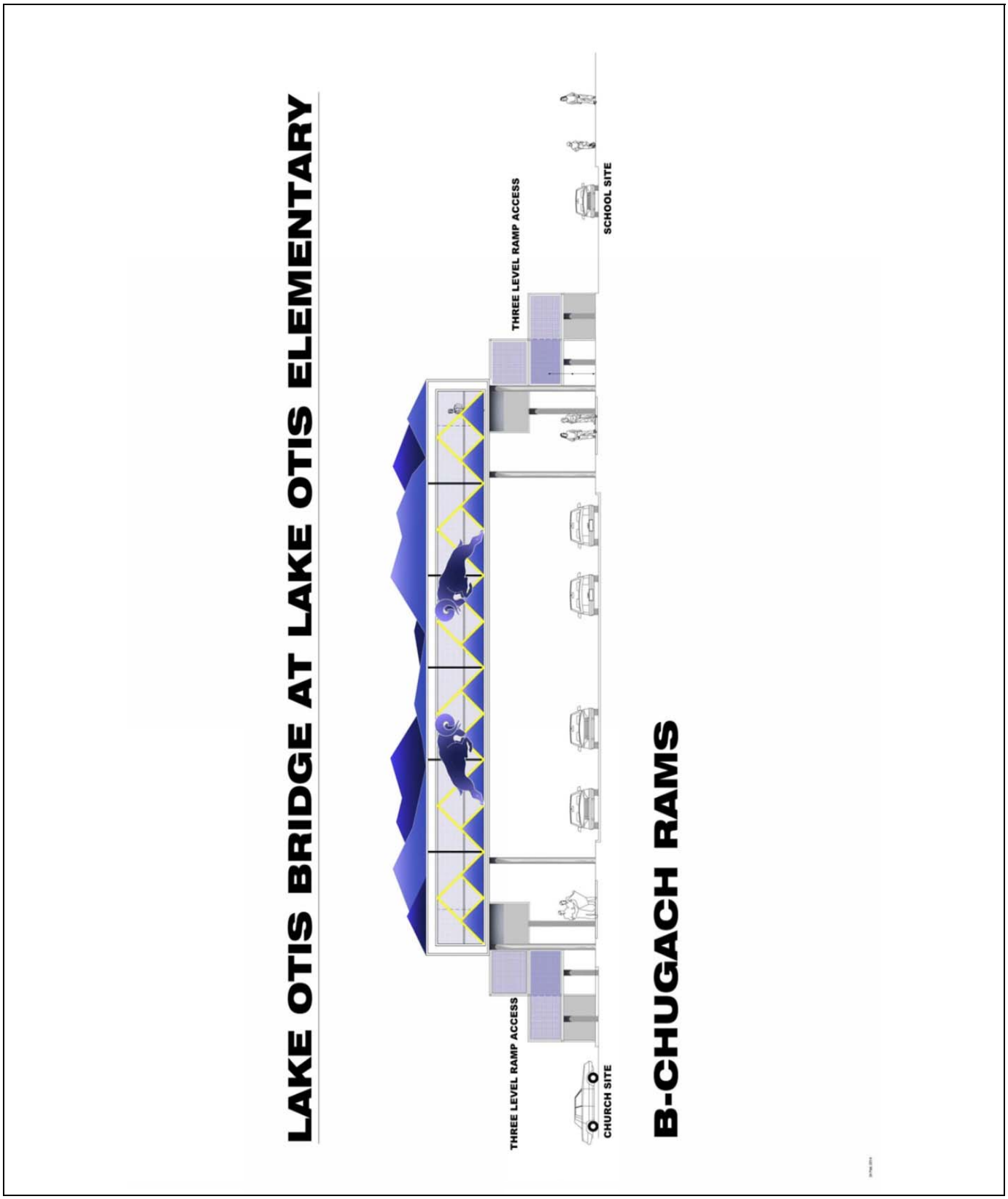
PLAN VIEW-ALTERNATIVE ACCESS RAMP ALIGNMENTS
LAKE OTIS BRIDGE AT LAKE OTIS ELEMENTARY
NORTH
LUTHERAN CHURCH
LAKE OTIS
LAKE OTIS ELEMENTARY
SINGLE RAMP
SINGLE RAMP
OVERPASS MOVED NORTH
LOOP RAMP TO CORNER
LOOP RAMP TO WALK
THREE LEVEL SWITCHBACK RAMP
CURRENT LOCATION OF OVERPASS
THREE LEVEL SWITCHBACK RAMP

LAKE OTIS BRIDGE AT LAKE OTIS ELEMENTARY

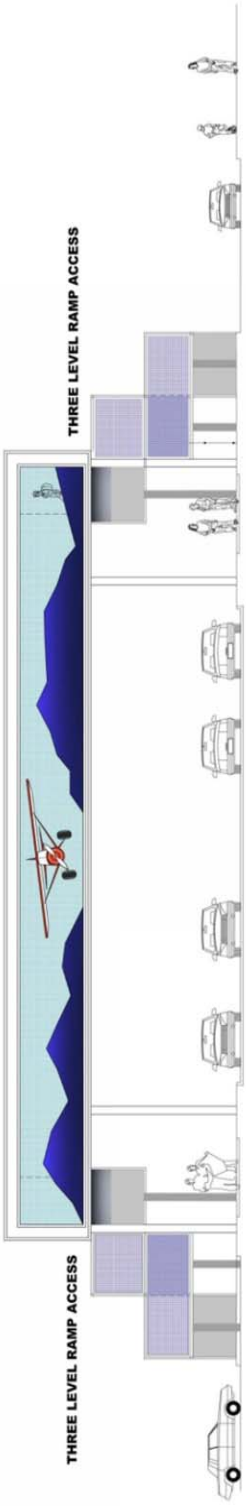


A-NORTHERN LIGHTS

THIS CONCEPT WOULD INCLUDE COLOR LED LIGHTING BEHIND THE NORTHERN LIGHTS RIBBONS AND COULD BE USED ON BOTH NORTHERN LIGHTS BOULEVARD AND LAKE OTIS

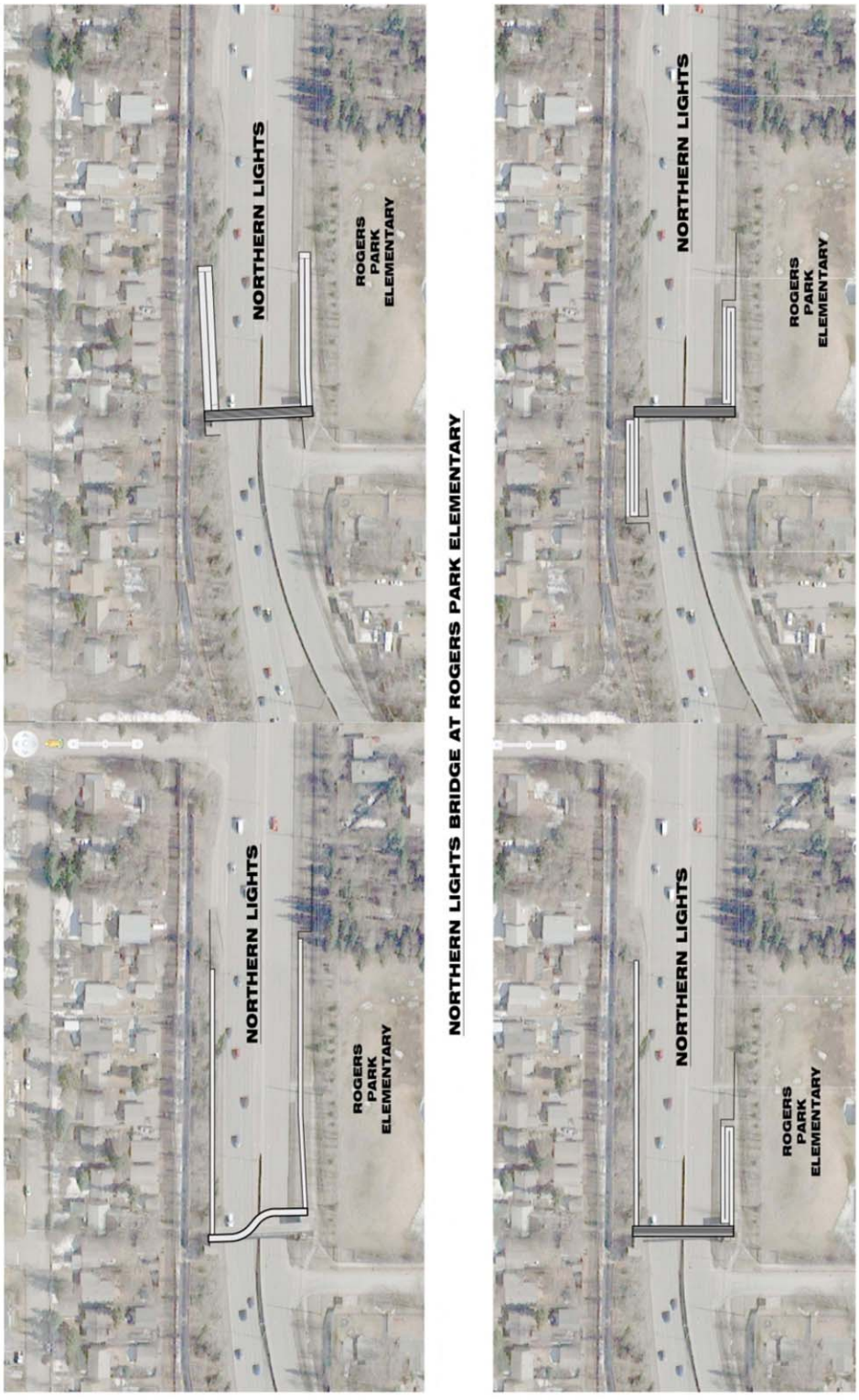

LAKE OTIS BRIDGE AT LAKE OTIS ELEMENTARY
THREE LEVEL RAMP ACCESS
SCHOOL SITE
THREE LEVEL RAMP ACCESS
CHURCH SITE
B-CHUGACH RAMS

LAKE OTIS BRIDGE AT LAKE OTIS ELEMENTARY



C-CONCEPT SUPER CUB

THIS CONCEPT COULD INCLUDE COLOR LED LIGHTING ON SUPER CUB AND A WIND DRIVEN PROPELLER

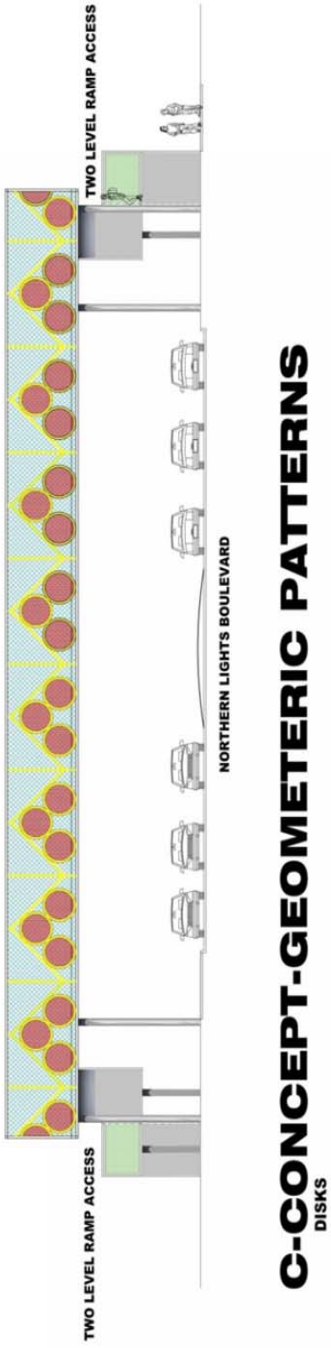

NORTHERN LIGHTS
ROGERS PARK ELEMENTARY
NORTHERN LIGHTS
ROGERS PARK ELEMENTARY
NORTHERN LIGHTS BRIDGE AT ROGERS PARK ELEMENTARY
NORTHERN LIGHTS
ROGERS PARK ELEMENTARY
NORTHERN LIGHTS
ROGERS PARK ELEMENTARY

NORTHERN LIGHTS BRIDGE AT ROGERS PARK ELEMENTARY

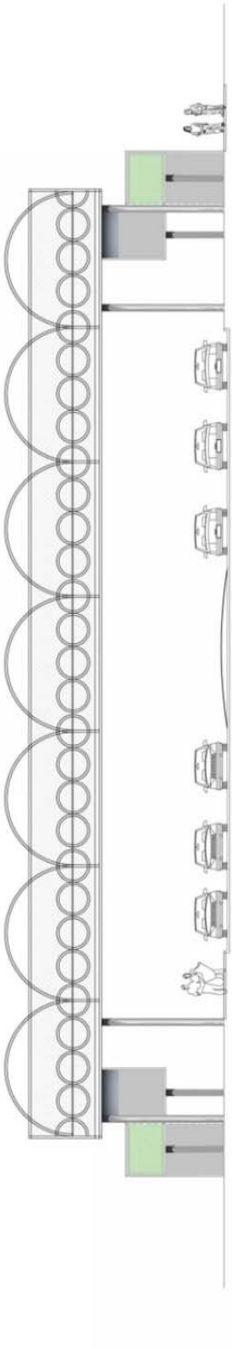
A-CONCEPT-SOW AND CUBS (or other mom and kids-moose and calves,etc.)

B-CONCEPT-GEOMETERIC PATTERNS

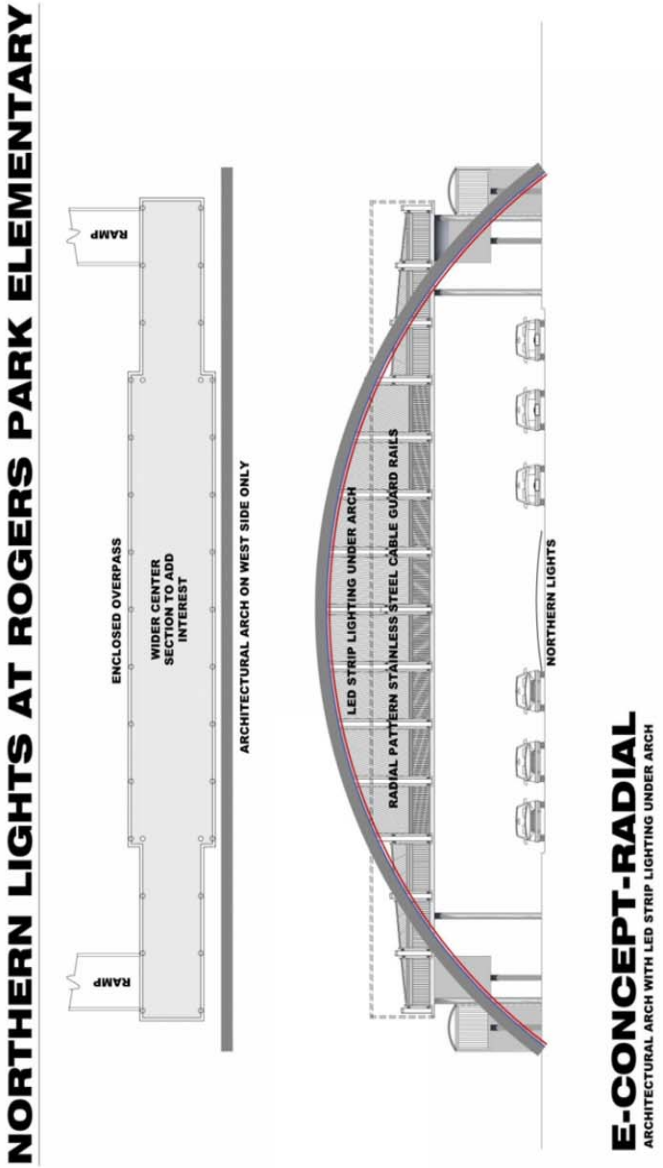
MOOSE AND SPRUCE

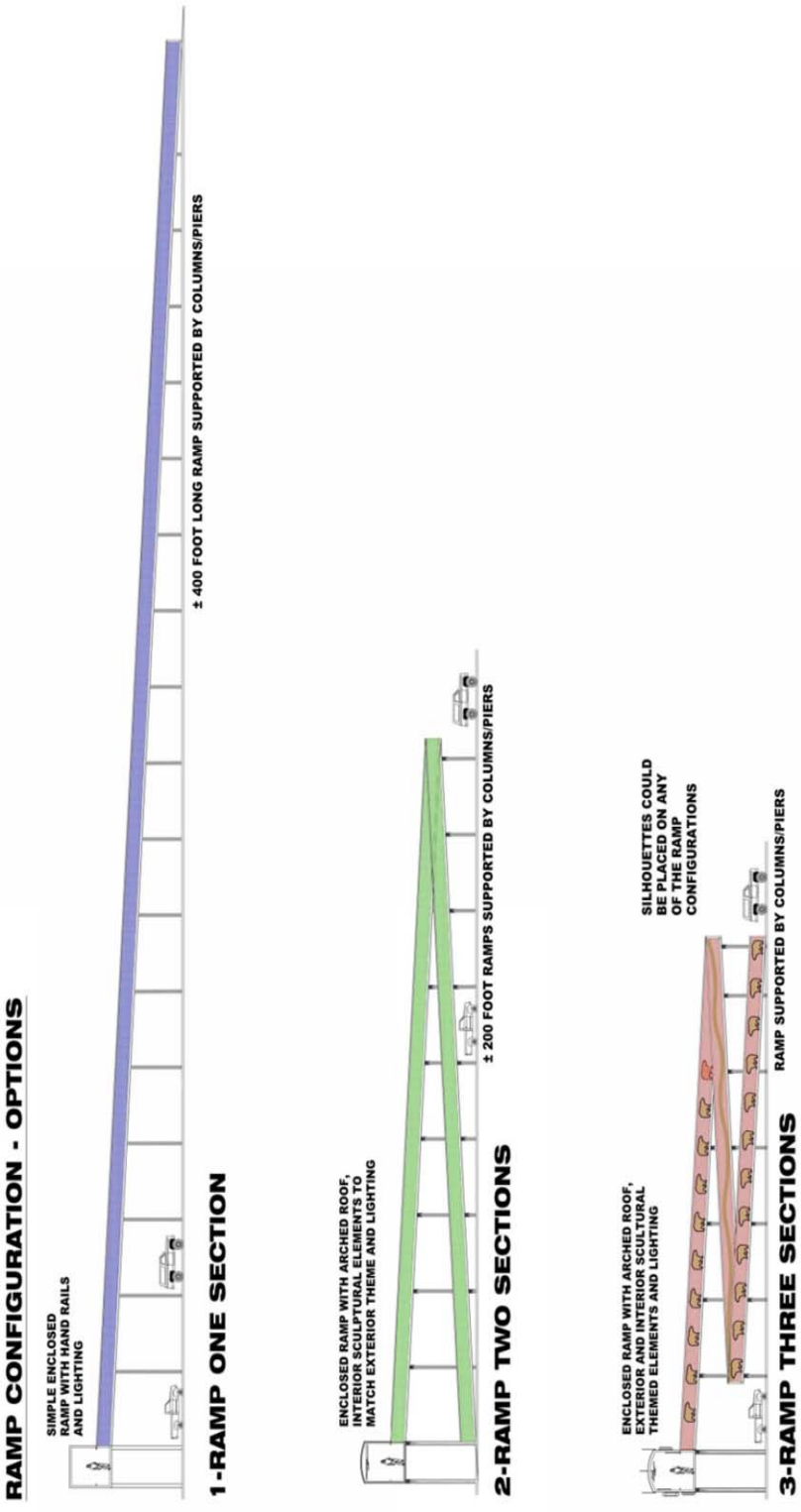


C-CONCEPT-GEOMETERIC PATTERNS
DISKS



D-CONCEPT-GEOMETERIC PATTERNS
RINGS


NORTHERN LIGHTS AT ROGERS PARK ELEMENTARY
RAMP
RAMP
ENCLOSED OVERPASS
WIDER CENTER SECTION TO ADD INTEREST
ARCHITECTURAL ARCH ON WEST SIDE ONLY
LED STRIP LIGHTING UNDER ARCH
RADIAL PATTERN STAINLESS STEEL CABLE GUARD RAILS
NORTHERN LIGHTS
E-CONCEPT-RADIAL
ARCHITECTURAL ARCH WITH LED STRIP LIGHTING UNDER ARCH


RAMP CONFIGURATION - OPTIONS
SIMPLE ENCLOSED RAMP WITH HAND RAILS AND LIGHTING
± 400 FOOT LONG RAMP SUPPORTED BY COLUMNS/PIERS
1-RAMP ONE SECTION
ENCLOSED RAMP WITH ARCHED ROOF, INTERIOR SCULPTURAL ELEMENTS TO MATCH EXTERIOR THEME AND LIGHTING
± 200 FOOT RAMPS SUPPORTED BY COLUMNS/PIERS
2-RAMP TWO SECTIONS
ENCLOSED RAMP WITH ARCHED ROOF, EXTERIOR AND INTERIOR SCULTURAL THEMED ELEMENTS AND LIGHTING
SILHOUETTES COULD BE PLACED ON ANY OF THE RAMP CONFIGURATIONS
RAMP SUPPORTED BY COLUMNS/PIERS
3-RAMP THREE SECTIONS

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Appendix C –
Cost Estimate

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Lake Otis							
Demo Exist Bridge			Lump Sum				$ 50,000
Utility Relocates							$ 200,000
West Ramp	Length	Max Ht	Avg Ht	# piles	Total Pile Lengh	Cost	
	420	25	25	42	1050	$ 240.00	$ 252,000
Ramp Structure	Length	Width			Area	Cost	
	420	10			4200	$ 300.00	$1,260,000
Bridge Foundation			Pile Length	# piles	Total Pile Length	Cost	
			50	8	400	$ 320.00	$ 128,000
Bridge Structure	Length	Width			Area		
	90	10			900	$1,150.00	$1,035,000
Subtotal							$2,925,000
Design						$ 0.15	$ 438,750
PM						$ 0.10	$ 292,500
Ca						$ 0.07	$ 204,750
Continigency						$ 0.30	$ 877,500
							$4,738,500
N. Lights Bridge							
Demo Exist Bridge							$ 50,000
Utility Relocates							$ 200,000
West Ramp	Length	Max Ht	Avg Ht	# piles	Pile Lengh	Cost	
	420	25	25	42	1050	$ 240.00	$ 252,000
Ramp Structure	Length	Width			Area	Cost	
	420	10		# piles	4200	$ 300.00	$1,260,000
Bridge Foundation			Pile Length	# piles	Total Pile Length	Cost	
			50	8	400	$ 320.00	$ 128,000
Bridge Structure	Length	Width			Area		
	117	10			1170	$1,150.00	$1,345,500
Subtotal							$3,235,500
Design						0.15	$ 438,750
PM						0.1	$ 292,500
Ca						0.07	$ 204,750
Continigency						0.3	$ 877,500
							$5,049,000

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Appendix D –
Pedestrian Bridge Crossing Data

Lake Otis Bridge

	Total	Eastbound	Westbound
Total	688	319	369
Peak Day	Fri, Jan 17, 2014 (148)	Fri, Jan 17, 2014 (68)	Fri, Jan 17, 2014 (80)
Minimum Day	Sun, Jan 19, 2014 (4)	Sun, Jan 19, 2014 (2)	Sun, Jan 26, 2014 (2)
Max Day of the Week	Friday	Friday	Friday
Hourly Average	2	1	1
Daily Average	57	27	31

Northern Lights Bridge

	Total	Southbound	Northbound
Total	717	375	342
Peak Day	Fri, Jan 17, 2014 (255)	Fri, Jan 17, 2014 (128)	Fri, Jan 17, 2014 (127)
Minimum Day	Sun, Jan 19, 2014 (11)	Sun, Jan 19, 2014 (4)	Sat, Jan 25, 2014 (5)
Max Day of the Week	Friday	Friday	Friday
Hourly Average	2	1	1
Daily Average	60	31	29

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