

Future Sidewalk Improvement Program Recommendation

June 3, 2019

The Honorable Mayor Fournier and
Members of the City Commission:

In January of 2019 the city commission directed staff to review the 2017 sidewalk replacement criteria (Attachment 1) in greater detail. An assessment of the 2012 sidewalk improvement area was completed in 2018 (Attachment 2) indicating the type and quantity of defective sidewalks after a six-year period.

The May 2019 review and analysis report (Attachment 3) is part is a detailed discussion regarding the type of defect that we currently address and possible alternative requirements and remedies. The objective is to discuss and evaluate options for alternatives to costly sidewalk replacement as a means of correcting both hazardous and non-hazardous defects. In the discussion, revising the current standards and methods of addressing them would consider the following:

- Potentially lower program costs: In the past the city has operated a sidewalk replacement program. This type of work is done by contractors in a bulk manner where efficiencies of scope and cost can be achieved.
- Establish repairs based on the hazard level of defect: Structurally sound sidewalks with minor defects could be passed over until they become hazardous, however this is likely just postponing the inevitable. Lesser defects could be temporarily repaired with less costly methods so long as the sidewalk slab remains structurally sound until the next round of sidewalk repairs
- Review the longevity of selected repair options: Singular deficiencies can be looked at individually, however sidewalk experiencing multiple defects should be addressed as soon as they are found. The city currently does not have the capacity to regularly monitor sidewalk conditions. It has been suggested to run a continuous program to assess sidewalk conditions and repair defects every five to six years. Previously, the city's sidewalk programs had up to 15 years between condition assessments. Perhaps more frequent assessments could allow some defects to remain so long as that hazard potential is low. It would be expected that a more regular sidewalk program could result in a smaller overall program.
- Simplify contractual and logistical operations: Minor repair techniques addressing less frequent types of defects could be done by property owners as operating a city run contract of minor work could be inefficient. Allowing property owners to repair minor defects at a lower cost could reduce the need for some seasonal workers.
- Easier to understand

Engineering's review and analysis indicates that in most instances, lowering standards for immediate replacement, will only delay the inevitable replacement at a higher price point. Allowing some temporary fixes also adds a current perhaps lesser cost but will still result in a future replacement.

In staff's opinion, the city's current standards are straightforward and easily demonstrated. Previously, the amount of complaint or debate as to the precise standard was rare. Most of these complaints raised the issue of the level of hazard should justify the treatment replacement. Lower

standards might be more acceptable to the public in the short term but not necessarily easier to understand and ultimately results in higher costs. Perhaps a solution to making the sidewalk program more understandable involves an additional educational component crafted to explain the program.

Should the city commission still wish to lower the city's sidewalk replacement standards and introduce temporary fixes as discussed in the report, the following resolution summarizes engineering's suggestions for managing an efficient sidewalk repair and replacement program. It should be noted that minor and temporary repairs are suggested to be allowed under permit to the property owner and would not be done by the city as we would not be able to guarantee a longevity to the repair or be able to cost effectively make the repair.

Be it resolved, the city commission hereby directs engineering to begin a new six-year sidewalk program in the spring of 2020, and

Be it further resolved, the city commission endorses the following sidewalks repair and replacement criteria:

1. Sidewalks that exhibit differential sidewalk elevations of one inch or greater would be replaced. A one-inch differential could be shaved or ground to meet city standards
2. Cracked or broken sidewalk with any of the following:
 - a. Sidewalks broken into three or more pieces,
 - b. Sidewalks where a crack is not tight and well seated,
 - c. Severe crazing (alligator cracking),
 - d. Deteriorating joints (at least four inches long by one-inch wide at any point)
 - e. Spalled areas (at least three inches along any one side).
3. Other Surface condition issues:
 - a. Pitted sidewalks with any pit larger than one and a half inch and at least a half inch deep,
 - b. Surface deterioration consisting of severe scaling or popping causing a safety issue.
4. More than one issue listed above.

Respectfully submitted,
Matthew J. Callahan, P.E.
City Engineer

Approved,



Corrigan O'Donohue
Acting City Manager and Chief of Police



2017 Sidewalk Replacement Criteria

The sidewalk replacement criteria were developed by the engineering division with help from the city attorney and approved by the city commission. The program targets an area of the city each calendar year between 2012 and 2017.

The city deems that sidewalks which exhibit the following criteria will be removed and replaced:

1. Sidewalks that exhibit differential sidewalk elevations.
 - a. Differentials typically occur at the joint between two sidewalk slabs. A differential consists of a lip or elevation difference at the joint and is measured along the vertical face of the joint. A differential sidewalk that exceeds a half inch is a condition that warrants removal and replacement. The differential may have been caused by tree roots, trench settlements, or heavy weights placed on the sidewalks.
2. Cracked or broken sidewalk with any of the following:
 - a. Hairline or crazing (alligator cracking),
 - b. Deteriorating joints (at least four inches long by one inch wide at any point)
 - c. Spalled areas (at least three inches along any one side)
3. Other Surface condition issues:
 - a. Pitted sidewalks with any pit larger than one and half inches and at least a half inch deep
 - b. Surface deterioration consisting of scaling or popping (greater than 50 percent of at least two quadrants of the sidewalk slab)
4. Grade or miscellaneous conditions:
 - a. Sidewalks that show signs of ponding water due to settlement
 - b. Excessive sloping, greater than one inch per 12 inches
 - c. Sidewalks not complying with the five foot wide city standard

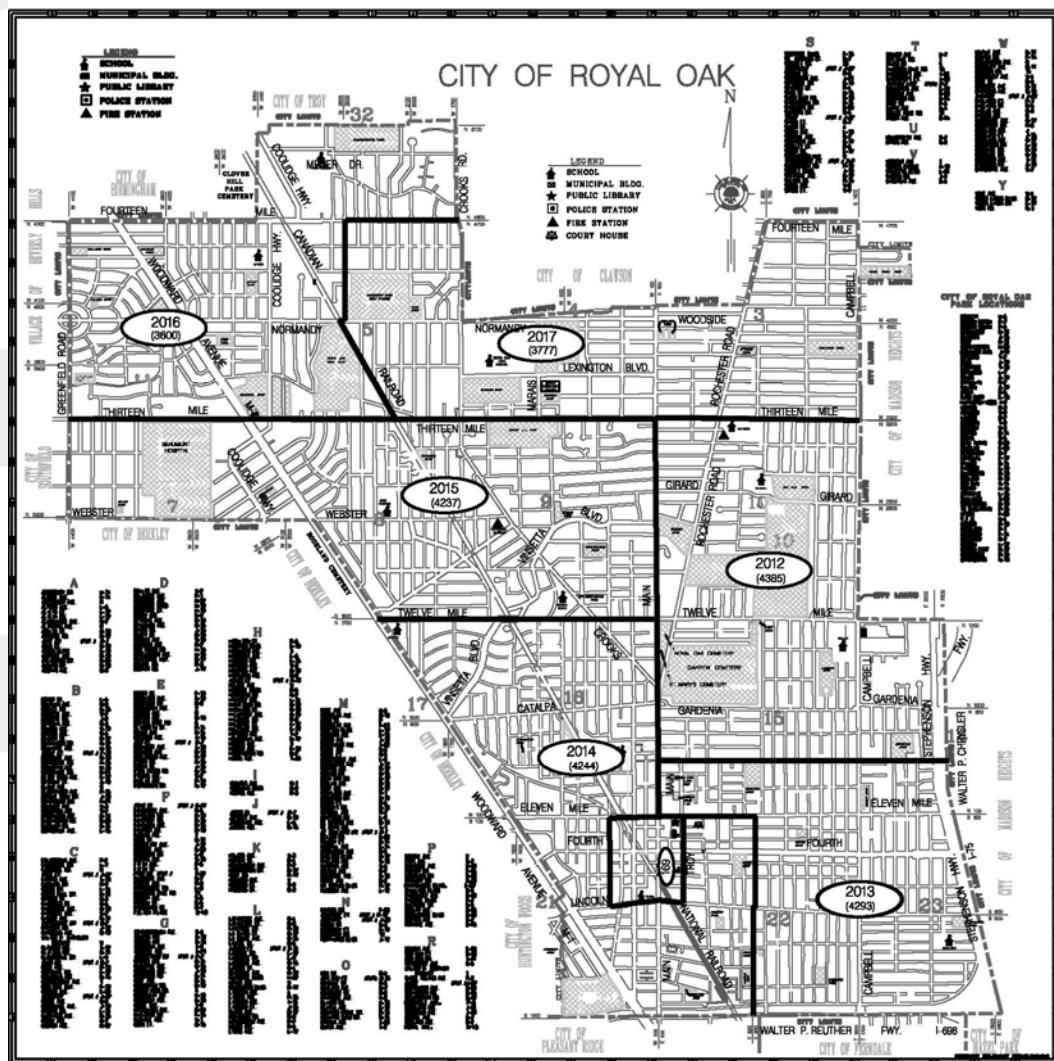
It should be noted that sidewalks may exhibit more than one type of deficiency. It should also be noted that the program not only addresses correcting identifiable sidewalk hazards, but includes defective sidewalks that may become hazardous before the next scheduled review and repair project occurs

2018 Review of 2012 Sidewalk Area

The 2012 sidewalk improvement program target areas bounded by North Main Street, East 13 Mile Road, North Campbell Road, East 12 Mile Road, Stephenson Super Highway, and East Farnum Avenue

Engineering staff revisited the roughly one and three-quarter square miles 2012 sidewalk target area to evaluate the current condition of public sidewalks in those neighborhoods. In 2012, the city's contractor replaced 282,200 square feet (SF) of sidewalk due to deficiencies. A current survey of this areas indicates 218,000 SF that meets the city's current criteria as follows:

1. Sidewalk with a half inch or more differential	= 44 percent
2. Cracked or broken sidewalk	= 31 percent
3. Surface conditions - significant spalling or popping	= 21 percent
4. Other conditions including excessive ponding	= four percent



CITY OF ROYAL OAK
PROPOSED 6 YEAR SIDEWALK PROGRAM

EXHIBIT A



Review and Analysis of The City of Royal Oak Sidewalk Criteria and Method of Repair May 2019

To start, here is some basic information regarding concrete and sidewalk construction to help better understand some of the discussed options being considered.

Concrete:

The concrete used for sidewalks consists of course aggregate (stone), fine aggregate (sand), cement, water, sometimes additives to increase workability, or improve material properties to adjust to weather. The city's concrete mixtures are designed specifically for each type of construction however all are required to meet minimum compressive strength of 3500 psi. Often, this minimum is exceeded. The cement material almost always contains cement components that minimize Alkali-silica issues that can cause scaling, crumbling and structural issues. During most times of the year, right after finishing, concrete is sprayed with an opaque waxy compound to seal in moisture needed for curing. The curing compound material eventually wears off over time. Concrete cannot be placed when it is too hot or too cold without special precautions as these extreme temperatures can prevent proper curing which can cause the concrete to fail.

Sidewalks Construction:

Sidewalk slabs are four-inch thick in areas not meant to be driven on. At regular driveways, sidewalks are six-inch thick and at commercial driveways they are eight-inch thick. American's with Disabilities Act (ADA) compliant sidewalk cannot exceed eight percent longitudinal slope or two percent transverse (side-side) slope. ADA compliant sidewalks cannot be narrower than three feet wide however Royal Oak's standards are five-feet minimum width. Sidewalks are typically constructed on well compacted base materials such as sand or stone. Almost all concrete pavements are constructed with joints to control cracking and separate areas where movement could occur, or expansion and contraction is expected.

Current defects that are addressed with the city's sidewalk program and potential adjustments.

1. Sidewalks that exhibit differential sidewalk elevations of half inch or greater.

A differential is considered where one slab has raised or lowered at the joint between two sidewalk slabs. There are numerous conditions that can contribute to or cause this type of occurrence, from tree roots which is the most common to settlement of soils beneath and adjacent to the slab, vehicles or other heavy weights on the slab, and others. Most of these occurrences are beyond the control of the city. In the past, replacement was the only option that the city allowed. It has been stated that any temporary measure just delayed the inevitable slab replacement and increased the overall cost of maintaining the sidewalk.

One of the main reasons for the city's past sidewalk improvement programs was frequent trip and fall lawsuits. Michigan recently amended its governmental tort liability act to further limit the liability of municipalities regarding open and obvious conditions. While cities continue to be liable for accidents on sidewalks that have a vertical discontinuity of two inches or more or are otherwise dangerous, the fact that the condition would have been open and obvious to an average person with ordinary intelligence is now a valid defense. This new law as well as a continuously running sidewalk program may be reasons to relax the city's half inch differential standard.

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The half inch differential limit was previously based on two concepts: half inch is the ADA required maximum threshold at a doorway. This criterion justified establishing the differential at which would keep sidewalks accessible to a recognized ADA standard.



Sidewalk differential greater than one inch



Sidewalk differential greater than one inch, wedged with temporary cold patch, lifted by tree roots

Sidewalks lifted by tree roots account for roughly 75 percent of the differentials based on our field inspections. Currently, when replacing the lifted slab, tree roots are cut to lessen the likelihood of a future occurrence. Lifting the lower sidewalk to match up with a higher tree root-lifted slab would be considered temporary as the affecting tree root has not been removed and will continue to lift the higher slab based on our observations.

Jacking is a term used to describe the process of injecting mortar or foam below the slab to raise it. This method is considerably less expensive than replacing a defective slab. Jacking may be effective where a sidewalk has settled but it would only provide only a short-term solution where

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a sidewalk has been lifted by a tree root and is not recommended in these locations as it does not address the main cause. In our opinion, jacking is better suited to lifting settled sidewalks and sidewalks with ponding issues as a long-term solution.

Property owners could be allowed to have elevation differences corrected by grinding/slicing of the raised edge or jacking of the lower slab by establishing finished product requirements. We would not suggest the city contract for those techniques itself; rather they could be done by at the direction and expense of the property owner in order to temporarily eliminate a sidewalk flag from the city's replacement program.

We have discussed altering the criteria to allow for elevation differences greater than half inch. The city could justify three-quarters inch or even one-inch differential. There is room for discussion on this. Also, would the city consider shaving or grinding sidewalks and to what extent. It should be noted that ground surfaces are often very smooth and friction for foot traffic could be an issue.



Sidewalk that has had a one-inch differential ground down

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Sidewalk with a three quarters inch differential ground down

If raising the threshold for repair is to be considered, staff believes that a three quarters inch differential may be acceptable if it is the only type of defect exhibited. For sidewalk differentials that exceed three quarters inch, staff believes that allowing property owners to grind the sidewalk one time for a maximum differential of one inch could be acceptable in areas where vehicles are not intended to drive, and in areas not being lifted by tree roots. This reduces the thickness of a sidewalk slab along one edge to no less than three inches thick to extend its service life. The city has researched grinding of sidewalks and there are several local companies that perform this work at a reasonable cost. As a courtesy, the city could provide this information. It is recommended that when the differential gets to one inch, some corrective action is taken such as grinding or replacement.

Based on preliminary discussions with our sidewalk contractors from past years, concrete slicing or grinding is not in their scope of services and they would have to outsource this operation for a small number of locations with contractor markups resulting in increased costs. Under a sidewalk program, we would recommend notifying property owners that this method could be utilized to address a specific defect location and that they could contract for this work themselves; otherwise the city would replace the flag in the normal manner. A permit would be required at a minimal cost and a timeline would be given to property owners to complete this work before the city acts.

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2. Cracked or broken sidewalk with any of the following:

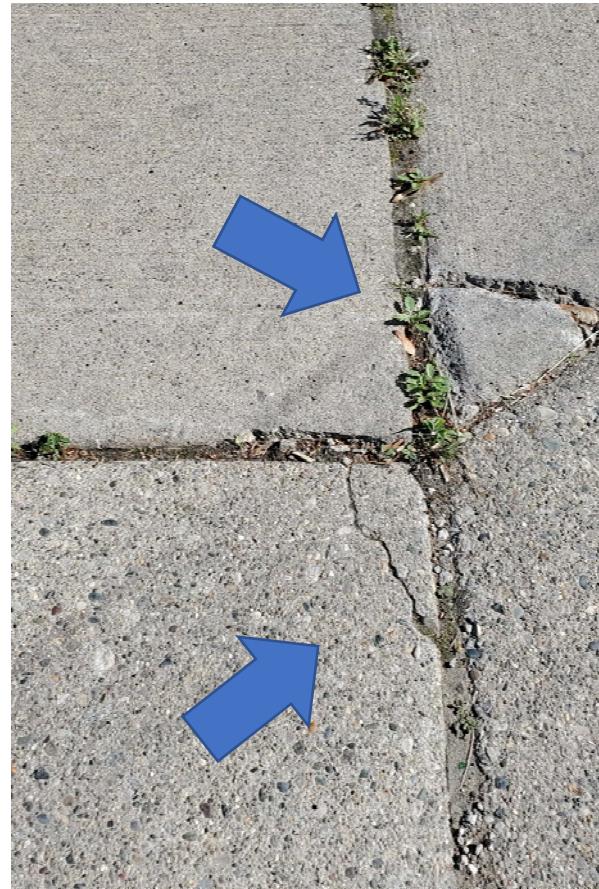
- a. Hairline cracking or crazing (alligator cracking)
- b. Deteriorating joints at least four inches long by one inch wide at any point
- c. Spalled areas at least three inches along any one side

Concrete cracking can include several types defects. Cracking of the slab entirely through the depth of the material is a structural defect. This type of cracking happens when a heavy weight is introduced to the surface.

Hairline Cracks: Some hairline cracks are well seated meaning they do not appear to be moving apart or up/down. The city could consider not replacing hairline cracked slabs provided it is the only type of defect exhibited. A base assessment for allowing a hairline crack is that the sidewalk is not cracked into more than two pieces. The location of these slabs would have to be tracked to be sure they are eventually addressed. It should be noted that skipping a defective slab only postpones the inevitable replacement



Tight hairline crack with just two pieces



Broken/cracked edges

Attachment 3

Other cracked sidewalks that appear to be moving apart or up/down or are cracked into more than two pieces are more prone to failure and should be replaced when found.



Tight hairline crack however with multiple pieces

Poorly seated crack > one quarter inch

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Crazing: Crazing is not necessarily a structural defect as it may not always be through the depth of concrete. Its causes are more often related to those that cause minor surface issues such as improper curing, freezing before fully cured or placed in hotter than ideal temperatures, drying out the concrete. The city could consider not replacing crazed sidewalk slabs provided it is the only type of defect exhibited and not exhibiting any structural issue.



Crazed concrete



More severe crazed concrete

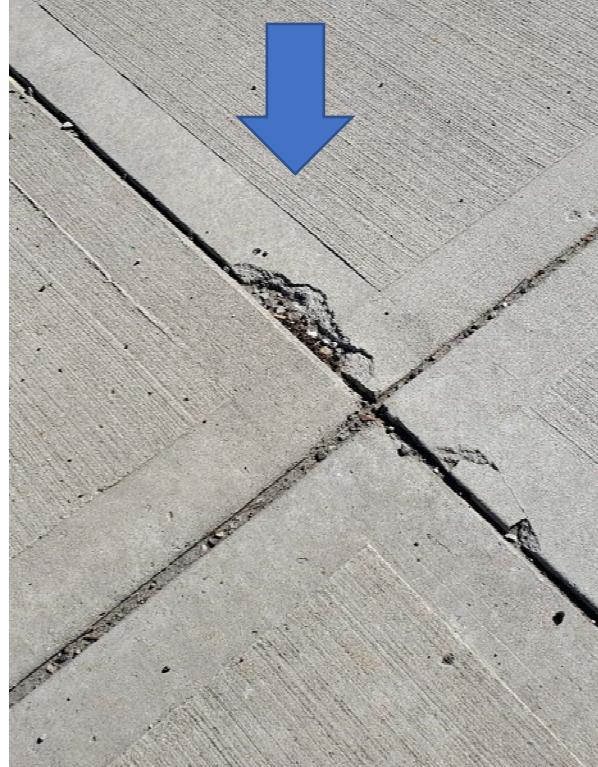
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Deteriorating Joints: Deteriorating joints can be caused by any number of reasons including impacts, heavy weights, excessive pitting or freezing of deleterious stones etc. These defects can cause tripping hazards when large enough and are often accompanied by other defects. The criteria size was defined during the last sidewalk program for better identification and explanation to residents. Deteriorating joints are difficult to repair using low cost methods as they are in an area where sidewalks are intended to crack. Movement at the joint can prevent patch material from being contained and from adhering. We do not recommend changing this criterion.

Spalling: Spalling is a deep fracture or blowout and can affect the structural integrity of the concrete. The causes of spalling are similar to those that cause deteriorating joints. These defects can cause tripping hazards when large enough and are often accompanied by other defects. We also do not recommend changing this criterion.



Chipped/deteriorating joint



Spalling joint

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3. Surface conditions with any of the following:

- a. Pitted sidewalks with any pit larger than one and half inch and at least half inch deep
- b. Surface deterioration consisting of scaling or popping (greater than 50 percent of at least two quadrants of the sidewalk slab)

Pitting: We have allowed property owner patching of sidewalk pits since 2014 to some degree of success. The patch material can readily be purchased and applied. Most pitted sidewalks are structurally sound and relatively old. Many of the remaining pitted slabs we have observed predate the first sidewalk programs started in the mid-1990's. Excessive pitting can lead to larger spalled areas which cannot be effectively patched. Staff believes that we could continue to allow homeowners to patch pitted sidewalks provided the slabs exhibit no other defect.



Pitted sidewalk



A patched pitted sidewalk

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Scaling: Scaling is essentially surface flaking and is seen typically in the first few years after construction and can be caused by a number of material or environmental factors as well as construction factors. Experts cannot necessarily determine the cause of scaling unless it is tested and found to be related to a material issue. Regardless of the cause, scaling is almost always exacerbated by deicing chemicals. Scaling is typically less than one quarter inch deep.

Scaling is not a structural issue with the slab that necessarily warrants a replacement. There is no low cost, long lasting minor repair procedure to repair scaling.



Scaled sidewalk slab

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4. Grade or miscellaneous conditions with any of the following:

- a. Sidewalks that show signs of ponding water due to settlement
- b. Excessive sloping, greater than one and half inch (eight percent)
- c. Sidewalks not complying with the five-foot wide city standard

Sidewalks that show signs of ponding water due to settlement.

When city staff inspects sidewalks, it is difficult to determine if a sidewalk ponds regularly and to what extent. Our inspections focus mainly on identifying and cataloguing defects previously discussed. We rely on homeowners to contact us regarding sidewalk ponding. In most instances, the original sidewalk where the ponding occurs has had this condition for some time.

Occasionally, a sidewalk slab is found settled due to poor underlying soil compaction which would currently be replaced as a method of correction. The city has gotten better at utility lead inspection in the right-of-way and forcing adherence to our compaction requirements, making this rare occurrence even less frequent. In most instances of ponding however, sidewalks exhibiting condition have not settled. What is occurring is the adjacent lawn areas have thickened due to many years of mulching, root growth and silt buildup creating a dam that prevents the runoff into the adjacent lawn. It is often demonstrated that adjacent lawn areas can be lowered to provide a drainage pathway and this lawn adjustment is left up to the property owner.

It should be noted that we receive regular complaints indicating that a new sidewalk is causing ponding, however we have found that the old sidewalk slab may have drained better due to the sidewalk defect and the new slab has corrected the defect but blocked a drainage pathway. This is not a flaw of the new sidewalk but more often a result from lawn buildup as noted above.

Water ponding on sidewalks is not considered a structural issue. It is a nuisance and can become problematic when ice forms, which may be only several days of weeks of the year. Icing can be effectively managed by the adjacent property owner. In order to determine the extent of ponding and the appropriate solution, considerable amount of staff time is required to survey and analyze the grades of the walk and surrounding areas. The cost to replace sidewalks at a higher elevation to promote positive drainage can be a costly but effective solution. Remember, that this cost is borne by the adjacent property owner.

It is possible to raise structurally sound sidewalks with jacking and other foam base treatments. While the city has not been approached to allow this type of repair on a ponding area, it could be allowed under certain conditions. Staff believes that we could allow homeowners to jack or foam treatment provided the slabs exhibit no other defect. It would not be allowed to raise a sidewalk slab to meet a higher slab being lifted by tree roots. A low-cost permit would be required to ensure an acceptable finished product.

Based on preliminary discussions with our sidewalk contractors from past years, concrete jacking is not in their scope of services and they would have to outsource this operation for a small number of locations, with contractor markups resulting in increased costs. Under a sidewalk program, we would recommend notifying property owners that this method could be utilized to address an area where ponding is occurring and that they could contract for this work themselves. A permit would be required at a minimal cost and a timeline would be given to property owners to complete this work before the city acts if they intend to do so.

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Excessive sloping, greater than one inch per 12" and sidewalks not complying with the five-foot wide city standard

There are very few instances where this condition exists. Almost all locations that we are aware of have been corrected. This criterion should still be mandated.