



KING COUNTY

1200 King County Courthouse
516 Third Avenue
Seattle, WA 98104

Signature Report

Motion 16200

Proposed No. 2022-0316.1

Sponsors Dunn

1 A MOTION acknowledging receipt of the Fairwood Golf
2 & Country Club flooding report as required by the 2021-
3 2022 Biennial Budget Ordinance, Ordinance 19210,
4 Section 99, as amended by Ordinance 19364, Section 70,
5 Proviso P1.

6 WHEREAS, the 2021-2022 Biennial Budget Ordinance, Ordinance 19210,
7 Section 99, as amended by Ordinance 19364, Section 70, Proviso P1, states that \$100,000
8 shall not be expended or encumbered until the executive transmits a report on Fairwood
9 Golf & Country Club flooding, and a motion acknowledging receipt of the report and the
10 motion is passed by the council, and

11 WHEREAS, the executive has transmitted to the council the requested report
12 entitled Fairwood Golf & Country Club flooding along with a motion acknowledging
13 receipt thereof by August 1, 2022;

14 NOW, THEREFORE, BE IT MOVED by the Council of King County:

Motion 16200

- 15 Receipt of the Fairwood Golf & Country Club flooding report, Attachment A to
16 this motion, is hereby acknowledged.

Motion 16200 was introduced on 8/16/2022 and passed by the Metropolitan King County Council on 9/6/2022, by the following vote:


Yes: 9 - Balducci, Dembowski, Dunn, Kohl-Welles, Perry,
McDermott, Upthegrove, von Reichbauer and Zahilay

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON

DocuSigned by:

7E1C273CE9994B6...
Claudia Balducci, Chair

ATTEST:

DocuSigned by:

8DE1BB375AD3422...
Melani Pedroza, Clerk of the Council

Attachments: A. Fairwood Golf and Country Club Flooding Report, August 1, 2022

Fairwood Golf and Country Club Flooding Report

August 1, 2022



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II. Proviso Text

Of this appropriation, \$100,000 shall not be expended or encumbered until the executive transmits a Fairwood Golf & Country Club flooding report, a motion that acknowledges receipt of the report, and a motion acknowledging the receipt is passed by the council. The motion should reference the subject matter, the proviso's ordinance number, the ordinance section, and the proviso number in both the title and body of the motion.

The report shall provide proposals to alleviate stormwater flooding affecting the Fairwood Golf & Country Club and neighboring property owners, which shall include, but not be limited to, applying for community grants, determining steps to address the stormwater line underneath the golf course, and addressing downstream outflows.

The executive should electronically file the report and motion required by this proviso no later than August 1, 2022, with the clerk of the council, who shall retain an electronic copy and provide an electronic copy to all councilmembers, the council chief of staff, and the lead staff for the local services committee, or its successor.

Ordinance 19364, Section 70, Department of Natural Resources and Parks Proviso P1¹

III. Executive Summary

This report identifies potential alternatives for alleviating stormwater flooding affecting the Fairwood Golf and Country Club (FGCC) and several neighboring properties from 2010 to 2019, describes potential community grant funding sources, and summarizes considerations for impacts on downstream outflows.

To prepare this report, the Stormwater Services Section of the Water and Land Resources Division (WLRD) researched and reviewed:

- Findings of past drainage investigations in response to complaints about flooding,
- The location and design of stormwater facilities,
- King County Code (KCC) pertaining to ownership and maintenance responsibility for stormwater facilities,
- Historic rainfall data for storm events, and
- Community grant funding options.

WLRD Stormwater Services also sought information from FGCC and the maintenance staff at the Fairwood Villa Condominium Homeowners Association (HOA) regarding maintenance practices and past projects. Staff from the Department of Parks and Natural Resources (DNRP) met with representatives of the FGCC, Fairwood Villa Condominium HOA, and neighboring property owners on March 18, 2022, to review rainfall and drainage investigation history, hear from community representatives about their observations of flooding and actions that have been taken to address it, outline potential alternatives and partnerships for alleviating stormwater flooding, describe potential grant funding sources, and discuss potential downstream impacts.

¹ Ordinance 19364 [[LINK](#)]

The FGCC and surrounding community were developed in the late 1960s and early 1970s. Stormwater flow control and water quality treatment facilities were not required at the time. Design standards were much lower than current standards, and the commonly used pipe material at that time was susceptible to root intrusions.

Five significant rainfall events have occurred since 2010, with the largest taking place on December 20, 2019. Rainfall in that storm event exceeded what is projected in a “100-year storm event” for this area. This amount of rainfall exceeds what the stormwater facilities are designed for, and flooding would be expected even if all facilities were maintained and functioning as designed.

Since 2010, the community has reported flooding on the 18th hole of the golf course and several surrounding properties. WLRD Stormwater Services investigated each instance. The reported flooding impacted the golf course, several properties adjoining the golf course to the north, crawlspaces of several houses adjoining the golf course to the north, and part of SE 173rd Street. Water has not been reported to have entered living space and no accidents have been reported related to the flooding of SE 173rd Street. The causes of the flooding have been determined to be tree roots in the pipe, large storms producing more runoff than the pipe was designed to convey, or a combination of both.

The Fairwood Villa Condominiums, upstream from the flooding on the 18th hole, experienced flooding of parking areas and landscaped areas in 2019. The flooding at the condominiums, which are located at a higher elevation than the golf course, does not appear to be related to the flooding on the 18th hole. Root intrusions into the pipes on the condominium property and runoff from a larger storm event than the system was designed for appear to have contributed to the flooding at the condominium complex.

Both the FGCC and the Fairwood Villa Condominiums HOA have undertaken maintenance and repair efforts. Under KCC, the owners of these private drainage systems are responsible for ongoing maintenance, operation, and repair. It is recommended that both the FGCC and the Fairwood Villa Condominium HOA continue regular maintenance and repair of their respective drainage systems in tandem with any further projects they might undertake to retrofit or replace these systems.

This report summarizes seven potential alternatives for replacement or retrofitting of stormwater pipes. The description of alternatives does not constitute a recommendation or endorsement of a particular alternative by the County. Property owners would need to pursue further feasibility analysis, permitting, and funding.

This report also describes a potential grant funding source to support further feasibility analysis, design, and construction (the King County Flood Control District’s Flood Reduction Grant Program) and provides a link to information on the Washington State Department of Ecology Grants site that could potentially be a funding option, depending on the type of project pursued by the property owners.^{2 3}

One significant drainage problem has been reported to Stormwater Services within a half-mile downstream of these properties; however, this problem was corrected with a construction project in 2017. Because actions to reduce flooding on one property have the potential to impact neighboring properties, the County recommends further coordination between neighboring property owners as they

² [King County Flood Control District’s Flood Reduction Grants Program](#)

³ [Washington State Department of Ecology Grants](#)

further explore project alternatives and grant funding proposals. If permits were required for a selected alternative, the permitting agency would require further evaluation of existing downstream problems.

The information contained in this report was discussed with representatives of the FGCC, members of the Fairwood Villa Condominium HOA, neighboring property owners and a representative from Council District 9 on March 18, 2022. Meeting participants from the Fairwood Greens HOA raised an additional question about ownership of a downstream parcel and reconciling their records with the County Assessor's Office records.

The meeting resulted in the following recommendations for next steps:

- The FGCC and the Fairwood Villa Condominium HOA could each evaluate the drainage system on their respective property to identify specific problem areas.
- The FGCC and the Fairwood Villa Condominium HOA could consider engaging a consulting engineer for detailed feasibility evaluations to determine the desired solution and design of that solution.
- The FGCC and the Fairwood Villa Condominium HOA could explore a partnership to apply for a King County Flood Control District (FCD) Flood Reduction Grant. The County provided contact information for further information on the FCD Flood Reduction Grant process. This follow up action is complete, and a grant was applied for.
- King County would attempt to clarify the ownership of parcel 2473481210, which the Fairwood HOA is currently managing, even though the King County Assessor's database did not show the Fairwood HOA to be the owners of the property. This follow-up action is complete.

IV. Background

Department Overview: The King County Department of Natural Resources and Parks (DNRP) works in support of sustainable and livable communities and a clean and healthy natural environment. Its mission is to foster environmental stewardship and strengthen communities by providing regional parks, protecting the region's water, air, land, and natural habitats, and reducing, safely disposing of, and creating resources from wastewater and solid waste.

The Water and Land Resources Division (WLRD) provides stormwater management services for unincorporated areas, supports three watershed-based salmon recovery forums, acquires open space, restores habitat, monitors water quality, controls noxious weeds, and provides economic and technical support for forestry and agriculture. As the primary service provider to the King County Flood Control District, the division reduces flood hazards to people, property, and infrastructure; inspects and maintains more than 500 river facilities; and partners in floodplain restoration. WLRD operates the County's Environmental Lab and Science sections, which provide environmental monitoring, data analysis, and management and modeling services to partners, jurisdictions, and residents throughout the region. The King County Hazardous Waste Management Program – a collaborative effort with the County and other King County municipalities – is also part of WLRD.

Key Historical Context:

Fairwood Golf and Country Club (FGCC)

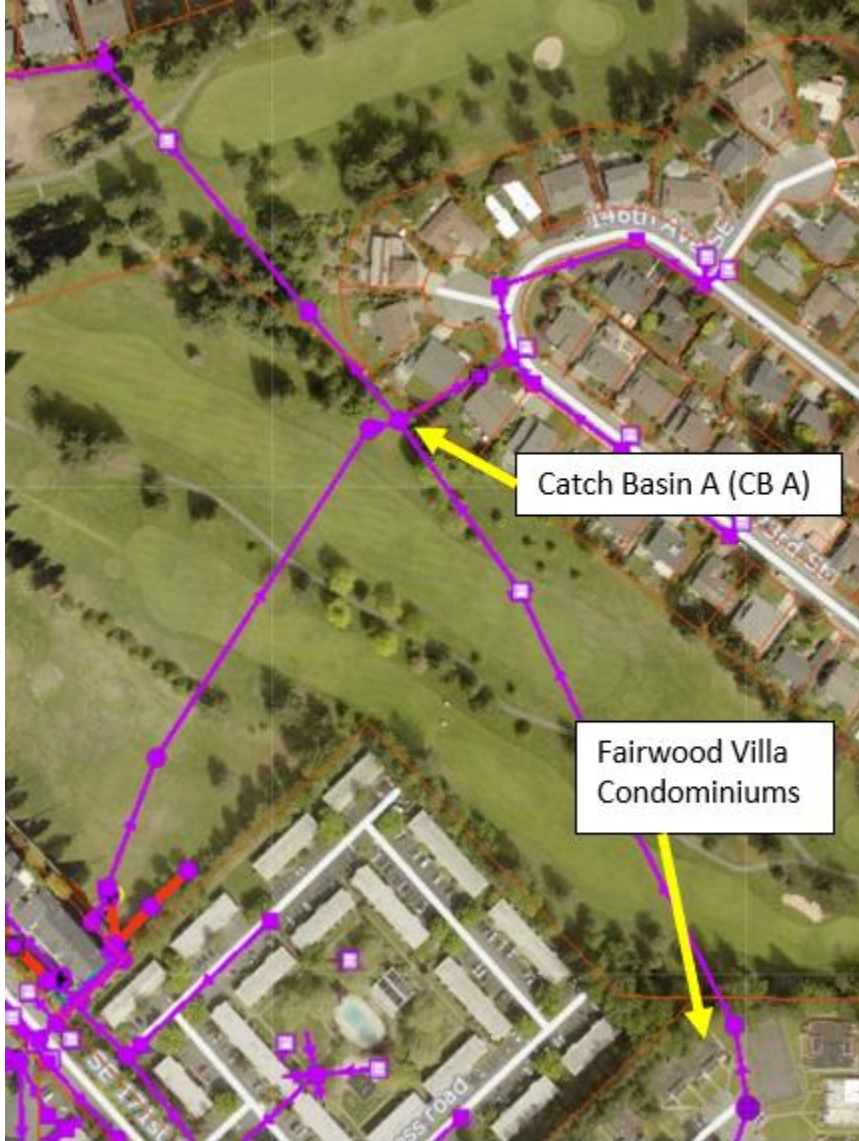
Ownership and maintenance responsibilities for stormwater facilities are outlined in KCC 9.04.120.⁴ The drainage system associated with flooding in this location is owned and maintained by the FGCC. The County has worked with maintenance staff at FGCC to identify the cause of the flooding and provide technical assistance for addressing the cause of the flooding. WLRD advised the FGCC to create a proactive inspection and maintenance program for drainage and stormwater facilities it owns and manages to prevent flooding of its property and surrounding properties.

The WLRD has received several reports of flooding on the 18th hole of the FGCC, starting in 2010, and has investigated the reported flooding each time. The drainage system related to this flooding is shown in Figure 1. Directly behind the house at 14607 SE 173rd Street is Catch Basin (CB) A. Three pipes drain into CB A and one pipe drains out of CB A.⁵ The pipes draining into and out of CB A are described in Table 1.

⁴ Link to [King County Code 9.04.120](#) - The person or persons holding title to the property and the applicant required to construct a drainage facility shall remain responsible for the facility's continual performance, operation and maintenance in accordance with the standards and requirements of the department and remain responsible for any liability as a result of these duties.

⁵ A catch basin joins pipe segments of different size or type and are required where pipe systems have a horizontal or vertical angle point. Catch basins also allow water to enter a pipe system.

Figure 1 : Drainage system near the 18th fairway of the FGCC shown in purple.



The flooding reported to the County starts at (catch basin) CB A with water surcharging out the top of the catch basin. Water also backs up into the 12-inch pipe coming from the northeast and surcharges from a catch basin in SE 173rd Street.⁶ The reported flooding covers part of the 18th hole of the golf course, several properties adjoining the golf course to the north, crawlspaces of several houses adjoining the golf course to the north, and part of SE 173rd Street. Water has not been reported to enter living space and no accidents have been reported related to the flooding of SE 173rd Street.

⁶ A surcharge means when water backs up within a drainage system and flows out of the grate on top of a catch basin rather than flowing into the catch basin.

Table 1: Characteristics of Pipes Draining Into and Out of CB A

Diameter (Inches)	Type	Direction From	What Drains to Pipe
12	Concrete	Into CB A from Northeast	Parts of SE 173 rd Street, 146 th Avenue SE, and SE 172 nd Street and the houses along these streets.
12	Metal	Into CB A from Southeast	Fairwood Villa Condominiums, Fairwood Pond Apartments, and part of SE 176 th Street and 147 th Avenue SE.
18	Concrete	Into CB A from Southwest	Fairwood Apartments, Heritage at Fairwood Condominiums, and part of SE 171 st Way.
18	Concrete	Out of CB A to the Northwest	Pipe discharges next to 140 th Avenue SE, approximately 2,000 feet to the northwest.

Flooding from the December 20, 2019, storm event is shown in Photos 1 and 2.

Photo 2: Looking southwest at the backyard of 14609 SE 173rd St.



Photo 1: Looking southeast from the backyard of 14609 SE 173rd St. at the flooding on the fairway and rough of the 18th hole of the FGCC.



By working with FGCC staff after the initial flooding report in 2010, WLRD determined that roots had grown into the concrete pipe downstream of CB A. Root intrusion into pipes is common and results in reduced capacity for the pipe system.⁷ Not only do the roots reduce the capacity of a pipe, but they also act like a strainer, catching debris that would otherwise flow through the pipe. Over time, root intrusion can lead to complete blockage of a pipe.

In response to previous flooding events, the FGCC inspected the pipe system downstream of CB A and hired a contractor to cut the roots that had entered a pipe. Cutting roots from a pipe improves conveyance capacity but does not remove all roots from the pipe; the roots will grow back in almost all cases. WLRD recommended the FGCC develop a plan for dealing with the anticipated regrowth of the

⁷ Root intrusions occur when tree roots grow through joints or cracks in pipes.

roots in the pipe. Components of such a plan could include inspecting the pipe on a regular basis, cleaning the pipe when needed, and removing the trees with roots that were suspected of growing into the pipe.

While root intrusions and other obstructions can cause flooding, storm events that create more stormwater runoff than a drainage system was designed to pass can also cause flooding. At the time the drainage systems in this area were designed, the size of the pipes were based on the amount of rainfall that fell over 24-hours. Rainfall gauge 31Y2 is located about half a mile from the 18th hole and has been in place since 2009.⁸ The top five 24-hour rainfall totals recorded at this gauge are shown in Table 2. The 24-hour total rainfall return frequencies at FGCC are shown in Table 3.⁹

Table 2: 24-hour Rainfall Total at Rainfall Gauge 31Y2 (approx. 1/2 mile from flooded 18th fairway)

Total Rainfall	Date	Approximate Return Frequency of Storm Event
3.97"	December 20, 2019, Ending at 4:00PM	Greater than 100-Year
3.05"	October 29, 2021, Ending at 9:00AM	Greater than 10-Year, Less than 25-Year
2.97"	December 12, 2010, Ending at 11:00AM	Greater than 10-Year, Less than 25-Year
2.63"	September 29, 2013, Ending at 1:00AM	Greater than 2-Year, Less than 10-Year
2.57"	January 18, 2017, Ending at 11:00AM	Greater than 2-Year, Less than 10-Year

Table 3: 24-hour Rainfall Return Frequency for Fairwood Golf and Country Club

Range	24-Hour Rainfall Total
2-Year	2.0"
10-Year	2.9"
25-Year	3.4"
100-Year	3.9"

Some level of flooding would be expected on the 18th hole during the December 2019 storm event, based on the design of the pipe system in the area irrespective of whether roots were growing in the pipe downstream of CB A,. King County policy at the time this pipe system was designed and installed (the design for the pipe system appears to date from 1966, and the construction appears to have occurred between 1968 to 1970) called for larger drainage systems (e.g., those receiving runoff from more than 50 acres) to be designed to convey the runoff from a 25-year storm event and smaller drainage systems to be designed to a 10-year storm event. There was no King County Surface Water Design Manual at the time of design/construction. Notably, even if the drainage system was designed to a 25-year storm event standard, the December 2019 storm event was above this design standard.

⁸ Gauge 31Y2: King County manages a network of rainfall measurement gauges across the county. Gauge 31Y2 is located at 14810 SE Petrovitsky Rd.

⁹ Return frequency: The probability that events such as storm events will occur is often expressed as a return period. Return frequency is the inverse of probability (generally expressed in %) and it gives the estimated time interval between events of a similar size or intensity.

Prior to December 2019, WLRD received several reports of flooding on the 18th fairway and surrounding properties. Other flooding events may have occurred but were not reported to WLRD. The reported flooding events are shown in Table 4 along with the highest 24-hour rainfall total preceding the report.

Table 4: Flooding Reports Before December 2019 and Highest 24-hour Rainfall Totals Likely Associated with the Flood Event

Flood Report Date	24-Hour Rainfall Totals and Date	Note
March 31, 2010	0.94 inches March 7, 2010	Less than a 2-year event
October 18, 2013	2.63 inches September 29, 2013	Less than a 10-year event
March 11, 2014	1.44 inches January 29, 2014 1.81 inches February 17, 2014	Less than 2-year events
February 15, 2017	2.57 inches January 18, 2017 1.92 inches February 16, 2017 (call likely came in during event)	Less than a 10-year event for January, and less than a 2-year event for February

Some of these flooding reports match up with the large storm events shown in Table 2, but some appear to be unrelated to large storm events. This pattern indicates that the flooding on the 18th fairway can be caused by large storm events above the design capacity of the drainage system or by obstruction in the drainage system during smaller storm events.

Fairwood Villa Condominiums

Flooding was also reported upstream of Photos 1 and 2 at the Fairwood Villa Condominiums. The flooding at the condominiums does not appear to be related to the flooding on the 18th fairway because the condominiums are about eight feet higher than the high-water level on the 18th fairway. In addition, there are catch basins between the 18th fairway and the condominiums that would allow water to surcharge from the catch basins before it could back up to the elevation of the condominiums.

The conditions that contribute to the flooding on the Fairwood Villa Condominium property appear to be related to the original development of the property. Construction plans for the condominiums show a drainage channel through the property prior to development. As part of the development, the swale was replaced with a pipe system.¹⁰ In addition, the downstream portion of the swale was filled to create a flat area near the tennis courts on site. The construction resulted in a closed depression that is drained by the pipe system.¹¹ If the pipe system is obstructed or overwhelmed, water ponds to the level of the filled area before it can flow downstream.¹²

The condominium drainage system was likely designed to convey the runoff from a 10-year storm event, based on King County policy at the time the system was designed and installed. In addition, prior inspection of the condominium drainage system by WLRD identified roots growing in some of the pipes. The condominium representatives were notified of the roots and asked to remove them.

¹⁰ A swale is a shallow drainage channel with gentle side slopes.

¹¹ A closed depression has no outlet other than overflow similar to a bowl in which water has to rise to the level of the rim of the bowl before it can flow out.

¹² Ponding is an occurrence where water accumulates in low-lying areas.

The management company for the condominiums was contacted in November 2021. The management company indicated that it was currently soliciting bids for a company to video-inspect and clean the condominium's drainage system. However, similar to the flooding on the 18th fairway, some level of flooding would have been expected, even if the condominium's drainage system was functioning as designed during the December 2019 event.

Key Current Context: Maintenance of the pipe system in the 18th fairway is currently the responsibility of the FGCC or its designee, and maintenance of the pipes on the Fairwood Villa Condominium property is the responsibility of the condominium HOA.

KCC 9.04.120 applies to all drainage facilities that have not been accepted for maintenance by King County.¹³ The FGCC has acted in accordance with KCC 9.04.120 during past investigation by WLRD by inspecting and maintaining the pipes in the 18th fairway as a result of past flooding reports. The HOA has hired a management company to maintain the drainage system on the condominium property.

Report Methodology: To prepare this report, the Stormwater Services Section in WLRD reviewed the history and findings of past drainage investigations in response to complaints about flooding at these locations, records of the location and design of stormwater facilities, KCC related to ownership and maintenance responsibility for stormwater facilities, history of maintenance and repair actions by the stormwater facility owners, rainfall data from storm events, and grant funding options.

In addition to reviewing County records and conducting site visits, WLRD Stormwater Services also sought information from FGCC and Fairwood Villa Condominium HOA maintenance staff. WLRD Stormwater Services also met with representatives of the FGCC, members of the Fairwood Villa Condominium (HOA), and members of the Fairwood Greens HOA which is near the FGCC, and a representative of Council District 9 on March 18, 2022, to hear community observations, review options for addressing stormwater flooding including potential partnerships, and describe potential grant funding. The meeting participants identified potential next steps and partnerships that they could undertake, including preparing a grant application to support further feasibility analysis, design, and construction of potential flood reduction projects.

V. Report Requirements

This proviso requires a report and motion to be transmitted to council by August 1, 2022. This report outlines potential alternatives to alleviate the stormwater flooding affecting the Fairwood Golf and Country Club and Fairwood Villa Condominiums. It also includes information about applying for community grants, determining steps to address the stormwater line underneath the golf course, and addressing downstream outflows.¹⁴

This report summarizes several alternatives, including alternative technologies for replacement or retrofitting of stormwater facilities that could reduce or eliminate the flooding impacts at the FGCC 18th

¹³ [Link to King County Code 9.04.120](#)

¹⁴ Outflows: discharges from a pipe.

hole and the Fairwood Villa Condominiums. Advantages and disadvantages are described for each alternative.

Notably, this report is not an engineering or permitting feasibility analysis and does not constitute County endorsement of a particular technology or contractor. The owners of the stormwater facility will need to pursue further feasibility analysis, permitting, and funding to alleviate flooding on their property. Because actions have the potential to have upstream and downstream impacts, it is recommended that neighboring property owners collaborate on further review of alternatives and feasibility analysis. WLRD Stormwater Services identified a potential grant funding option and contact for further information.

A. Information about applying for community grants to alleviate flooding

Typically, grant funds are designated to address specific problems, such as fish passage, water quality, or flooding. Finding an appropriate grant opportunity depends on the specifics of a project.

One potential source of grant funding is the King County Flood Control District's Flood Reduction Grant Program, which WLRD administers on behalf of the King County Flood Control District.¹⁵ WLRD provided information about the Flood Reduction Grant Program at the meeting with community representatives on March 18, 2022. The total amount of funding available for Flood Reduction Grants for 2022 is \$12 million. There is no minimum or cap on the individual award amount. Grants awarded in the past have ranged from \$10,000 to \$1,500,000. Matching or leveraged funds are encouraged but not required. The expenditure of funds must be completed no later than 36 months after the grant agreement is signed. Projects included in the grant application need to reduce flooding, and proposals may be phased so they include site assessment, design, and/or permitting only, as long as the application demonstrates that these early phases will ultimately lead to construction of on-the-ground structural improvements in a future phase.

In addition, the Washington State Department of Ecology, has an extensive [grant program](#) that includes options that might be appropriate, depending on the project strategies these land owners choose to pursue.

B. Determining steps to address the stormwater line underneath the golf course

Seven potential alternatives for addressing the flooding on the 18th hole of the FGCC and Fairwood Villa Condominiums are listed below. These alternatives are possible ways to reduce or eliminate the flooding. Advantages and disadvantages of each alternative are listed. There may also be advantages and disadvantages not listed that have a less impact on the potential action. Alternatives are listed in no particular order and no preference should be implied by the order listed. Combinations of alternatives may also be considered. All alternatives require ongoing inspection and maintenance, although some options can minimize the cost of maintenance going forward. Any alternatives considered for implementation should have a feasibility study performed by a qualified consultant to select and site a preferred alternative or mix of alternatives described below. All listed alternatives may require permits from local, state, and/or federal agencies, which may affect the desirability of an alternative.

¹⁵ [King County Flood Control District's Flood Reduction Grant Program](#)

Potential Alternative	Advantages	Disadvantages
<p>1. Status Quo (inspect pipes regularly and cut roots or clean pipes when needed): Routine inspection and maintenance performed when needed is the most common maintenance practice for drainage facilities in King County. This alternative requires the property owner to be proactive regarding the inspection of the drainage facility and not wait for observed problems before inspection. Identified maintenance needs should be addressed promptly.</p>	<ul style="list-style-type: none"> • Common and routine way to maintain drainage facilities. • Does not require a large initial capital investment. • FGCC and Fairwood Villa Condominiums already have active maintenance programs. 	<ul style="list-style-type: none"> • Deferred maintenance may lead to damaging impacts and potential liability. • Does not require large initial capital investment. Would not eliminate flooding during rainfall events that are larger than what the stormwater pipes were originally designed to handle.
<p>2. Replace Pipes: Replacing the existing pipes is the most reliable way to prevent future flooding. Replacement could be done by traditional excavation or by newer technology, such as pipe jacking or boring.</p>	<ul style="list-style-type: none"> • New pipes would be sized according to current design standards. • New pipe materials and connections are less susceptible to root intrusions. • Regardless of whether the pipes are replaced in their current location or relocated, the selected path would be cleared of trees for traditional excavation construction, making root intrusion less likely. • Future inspection and maintenance costs would be expected to be much lower than inspection and maintenance costs for the existing pipe. 	<ul style="list-style-type: none"> • Requires a large initial capital investment. • Requires removing trees from the pipe alignment. • If the pipe size is increased, the project should extend to the outlet of the existing pipe system, not just replace the section of root-affected pipe. • A suitable staging area is needed for jacking or boring alternative. • Undetected objects in the path of a boring or jacking project can delay the project and lead to higher-than-anticipated costs.
<p>3. Line Pipes: Lining an existing pipe is a relatively new technology that consists of inserting a flexible tube through the pipe, then inflating the tube and curing it in place to form a continuous liner inside the pipe.</p>	<ul style="list-style-type: none"> • Does not require excavation of the entire pipe alignment. • Provides continuous protection of a pipe, with no seams that roots can enter. 	<ul style="list-style-type: none"> • Requires the pipe to be clean and in straight alignment. • The liner slightly reduces the cross-sectional area of

Potential Alternative	Advantages	Disadvantages
	<ul style="list-style-type: none"> Initial capital investment is less than that of the pipe replacement option. 	<p>the pipe and, therefore, the capacity of the pipe.¹⁶</p> <p>May require additional work to compensate for the small loss of capacity.</p>
<p>4. Pipe Bursting: Pipe bursting is similar to the option of lining the pipe, except instead of a flexible liner inserted into the pipe, a bursting head is inserted into the pipe. The bursting head expands to break the existing pipe and pulls a new pipe through the expanded tunnel.</p>	<ul style="list-style-type: none"> Does not require excavation of the entire pipe alignment. Provides a continuous pipe with no seams that roots can enter. Allows for the installation of the same size pipe or larger than the existing pipe. Initial capital investment is less than pipe replacement. 	<ul style="list-style-type: none"> Requires a work pit to be excavated at the upstream and downstream end of the pipe. Soil conditions can limit the size of pipe to be installed.
<p>5. Remove Pipes and replace with open conveyance: Excavate to the level of the pipe and remove the pipe. Leave an open channel for water to flow through.</p>	<ul style="list-style-type: none"> The resulting open channel can be maintained with landscaping equipment typically already owned by a golf course or maintenance vendor. Open channels can be integrated into the golf course as penalty areas or other features. Open channels have higher capacities than similarly sized pipes. Open channels are more environmentally friendly than pipes in that they allow for increased infiltration of runoff quantities and removal of 	<ul style="list-style-type: none"> If the pipe is relatively deep, the technique would require a wide channel to provide stable side slopes. Requires removal of trees through the excavation area. Maintaining the side slopes of a channel is more difficult than mowing the existing area. Requires establishment of crossing for golfers and golf carts.

¹⁶ In some cases, if the existing pipe is very rough inside the barrel of the pipe, the new liner, even with a smaller cross-sectional area, can provide the same capacity as the existing pipe due to the lower roughness coefficient of the liner.

Potential Alternative	Advantages	Disadvantages
	<p>pollutants contained in stormwater runoff.</p> <ul style="list-style-type: none"> Initial capital investment is less than pipe replacement. 	
<p>6. Remove Pipes and replace with water features to improve flow control and/or water quality treatment: Instead of constructing an open channel, this alternative would build a larger water feature that could function as a facility to improve flow control and/or water quality treatment. The water feature could be integrated into the golf course as a new penalty area.</p>	<ul style="list-style-type: none"> The area was developed without flow control or water quality requirements, so a facility would enhance stormwater management functions. If sufficient storage or treatment could be provided for additional public benefits, the project might qualify for additional grant funding or other public funds. If designed as a flow control or water quality facility, those properties served by the facility could receive a discount on their Surface Water Management fee. 	<ul style="list-style-type: none"> To provide meaningful benefit for flow control or water quality treatment, the footprint of a facility would likely be very large and potentially cover portions of the existing golf course. Maintenance of a flow control or water quality facility is more complex than for an open channel. Any floatable pollution in the water stream would collect in the facility. Requires large initial capital investment and ongoing maintenance. Requires a way for golfers and golf carts to cross or get around the facility.
<p>7. Graded Overflow Path (at elevation that does not back up to houses or street): This alternative would involve excavating an open channel or broad swale to allow water to flow downstream before ponding high enough to impact the surrounding properties. The depth of the channel/swale would be determined by the elevation of the areas to be protected.</p>	<ul style="list-style-type: none"> The resulting open channel can be maintained with landscaping equipment typically already owned by a golf course or maintenance vendor. Prevention of flooding on the adjoining properties and SE 173rd Street due to unexpected obstruction or occurrence of storms between maintenance cycles may reduce potential liability. A channel could be integrated into the golf course as a new penalty area or into the 	<ul style="list-style-type: none"> Requires the channel/swale to extend to an acceptable discharge point, such as a downstream catch basin or surface overflow path. May require removing trees through the regraded area. Modest initial capital investment.

Potential Alternative	Advantages	Disadvantages
	landscaping of the condominiums. <ul style="list-style-type: none"> • A broad swale could be designed to not impede traffic across the swale. 	

C. Addressing Downstream Outflows

During the March 18, 2022, meeting, FGCC representatives expressed concern about potential downstream problems that may arise or be exacerbated by clearing or replacing upstream pipe sections.

One area of concern is at the outlet of the FGCC drainage system, where the flow then passes under 140th Avenue SE (140th). Members of the FGCC described ponding at the culvert under 140th, specifically during the December 2019 event. As noted above, the magnitude of the December 2019 storm event was such that ponding would be expected near the inlet of most drainage systems. Reducing upstream flooding could increase the amount of water flooding the area upstream of 140th. However, the flooding upstream of 140th only occurs during large flood events when it is not typical for golfers to be on the course. Any additional water ponding upstream from 140th is not expected to be enough to affect the amount of maintenance needed to clean up the flooded area upstream of 140th.

Another area of concern is in the downstream plat of Fairwood Park Division 4, which is about half a mile downstream from the FGCC. A drainage system in this plat experienced significant problems related to the pipe decaying about 10 years ago. The decayed sections of pipe were replaced, and actions taken on the FGCC or the Fairwood Villa Condominiums are not expected to negatively affect the drainage system in Fairwood Park Division 4. If permits were required for a selected alternative, the permit agency would require further evaluation of existing downstream problems.

VI. Next Steps

Prior to conclusion of the March 18, 2022, meeting at the FGCC, several next steps were identified including:

- The FGCC has video-inspected its drainage system from the 18th hole to the outfall near 140th.
- The Fairway Villa management company intends to have the condominium drainage system video inspected.
- The FGCC and the Fairwood Villa Condominium HOA will review the inspection of their drainage system to identify specific locations that may need to be maintained, repaired, or replaced. If potential projects are identified, the FGCC and the HOA will engage consultants to scope potential projects and conduct a feasibility analysis.
- The FGCC will review the website for the King County Flood Control District Flood Reduction Grants and contact the grant coordinator, if needed, to better understand the grant program and identify potential projects that match the grant program requirements. This follow up action is complete, and a grant was applied for.
- If both the FGCC and Fairwood Villa Condominium HOA identify projects suitable for the Flood Reduction Grant Program, they would cooperate to potentially submit a joint application.

Although it was not directly related to the flooding on the FGCC or the Fairwood Villa Condominiums, members of the Fairwood HOA asked for help clarifying the ownership of parcel 2473481210, which the Fairwood HOA is currently manages. The King County Assessor's database does not list the HOA as owners of the property. County staff agreed to investigate the matter, which was resolved by confirming the Fairwood HOA owns the parcel and updating the King County Assessor's database to reflect the correct ownership.

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