RAMSEY-WASHINGTON METRO WATERSHED DISTRICT

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Memorandum

To:	Board of Managers and Staff
From:	Tina Carstens, Brad Lindaman, and Erin Anderson Wenz
Subject:	Staff Response to Manager Questions/Comments Regarding West Vadnais Lake to South I-694 Conveyance Feasibility Study
Date:	August 3, 2020

Last month, Barr presented the technical report for this feasibility study. As described in July's status report, several pumping considerations were also presented. At the July board meeting, the managers were asked for feedback on the feasibility study. Since last month, we have received the following comments, questions, and feedback from two managers. Their feedback and questions, along with staff responses, are included below for board consideration.

Feedback from Manager Ward

Responses in italics

1.0 Background

Change "2016" to "when the RWMWD took over the area," or at least to "2014" per charts on p. 9. The biggest flood event, and, apparently the first information the RWMWD had about the issues north of I-694, was in late 2016. However, high water and flood events occurred earlier.

Okay. To clarify, the RWMWD was aware of the flood event in 2014, but at that time, the City of Shoreview indicated that it needed no additional assistance from the RWMWD.

Please stop citing the "wet precipitation cycle" as the ONLY cause of the "sustained high water levels..."

- It is one thing to be happy that the newspaper reporter on the Twin Lake article didn't look any further. It is another thing to keep saying this when the Board of Managers, residents following Board meetings, and other interested parties know better. It hurts our/RWMWD's and Barr's credibility.
- The "wet precipitation cycle" certainly contributed to Grass Lake and West Vadnais Lake flooding. However, it was not the ONLY cause. The drainage problems that caused the water to build up and the surrounding soils to be saturated, as well as the unnatural outlets in both lakes that created the overflow routes were also causes. The RWMWD has acknowledged this by fixing these issues.
- The increased precipitation cycle was predicted before these flood events. See 1.1 Beltline Resiliency Study. Citing only precipitation as a "cause" comes across as an "excuse." But, anyone who is aware of the actual increased precipitation and predictions wonders why increased precipitation wasn't, instead, a "reason" to act sooner to understand the areas in the RWMWD jurisdiction north of I-694 and fix the apparent problems. Again, it hurts RWMWD and Barr credibility. Be honest about the past causes or leave out the causation statements. Let's just move forward and do better in the future.

The wet precipitation cycle (and associated increases to regional groundwater) is the primary driver of the issues in this part of the RWMWD and is consistent with modeling and observations in neighboring watershed districts. Regardless of past maintenance, or storm sewer connections in this area, modeling indicates that we would still be navigating the current flood issues. Maintenance of structures certainly is important and helps keep water moving. Storm sewer design that takes into account future changes in precipitation and water levels is crucial; however, some of the pipes that are left in this area were placed many years ago, before precipitation records were updated. The magnitude of precipitation we have experienced in recent years is unprecedented and strains these systems, so we must make careful changes going forward.

I also take exception with the language about "working to identify and mitigate flood risk." This was not done in the Grass Lake area until after residents reported the problems in late 2016. It was not done in the Twin Lake area in the recent past either, at least in time to prevent the flooding by fixing the berm and improving the outflow from West Vadnais Lake.

Soon after the Atlas 14 precipitation record in 2013, the RWMWD updated all of its XP-SWMM models, resulting in updated maps that were distributed to member cities in 2014 and 2015. This work in the Grass Lake immediate area and Twin Lake did not reveal any flood threats to structures; however, our focus in that study was heavily weighted toward protection of structures, as has been discussed in the past.

You state the "recently completed and ongoing projects," e.g. fixing the berm where West Lake Vadnais water overflowed to Twin Lake, removes habitable structures out of the flood plain. When? Are they not at risk now under current conditions, or not at risk when the outlet is installed, or not at risk when West Vadnais Lake finally lowers, or not at risk as a result of the emergency pumping system, or, not at risk until an alternative presented in this study is completed? Please clarify. In the summary section, 9.0 you state: "This new stormwater pipe would achieve the goal of establishing the normal water elevation of West Vadnais Lake at 881.0, and the 100 year flood level at elevation 884.0." So, be direct and say that the goal can't be achieved without it (or, without year round pumping?), if that is the case. Is that the case?

Between lowering of the West Vadnais Lake outlet, repair of the overflow berm between West Vadnais Lake and Twin Lake, and the bypass system that can divert future West Vadnais Lake overflows around Twin Lake, staff feel that Five Star Estates is protected to a degree similar to other areas in the RWMWD. Some localized flood protection may be warranted for manufactured homes nearest the bypass system, but not to the degree that necessitates a larger project at this time.

You repeatedly said in the Beltline Study, e.g. in 3.1.3, "[I]improvements to the downstream portions should be constructed prior to increasing the discharge conveyed from upstream areas." In this report you state: "Increasing the discharge through I-694 without down stream improvements or particular timing constraints raises flood levels in downstream water bodies that have adjacent homes in the flood zone…" I thought that the Keller and Phalen weirs were givens, and will include timing constraints, so why this language? The modeling underlying the report the Board is given should include these factors as completed. This is especially obvious given this big project could not be completed soon (the costs of the project will require time to plan for and/or outside funding).

Modeling of the arch pipe presented in section 6.0 of the main body of the report (as well as the year-round pumping scenarios in attachment C) does assume that downstream controls are in place to allow for more flow from West Vadnais Lake. The Keller and Phalen weirs are moving forward. The decision to

build a bypass pipeline around Owasso Basin that would connect the flow, however, remains for the board to discuss at future board meetings.

The goal is to "establish the water level of the West Vadnais Lake system closer to elevation of 881.0…" "Closer to" is too mushy. Please specify a specific goal, e.g. 881.0 or, if justified, another level. Then, if it is 881, how does it go up 3 feet to 884 in a 100-year rain event?

Our terminology is a nod to the fact that lakes bounce during storm events. We can't expect the lake to always hit that elevation, given the large tributary area and constant inflows. Going forward, regardless of the board's ultimate decision about conveyance options, West Vadnais Lake will bounce during a storm event. When we use the term "normal water level," we are referring to the elevation that a lake returns to after a storm event has completely moved through the water body, and not an elevation at which the lake remains all the time.

The Beltline feasibility study used a desktop planning model. Are you doing any field surveys as you now more closely evaluate system modifications in each area?

Yes. Extensive field surveys have been completed for the other feasibility studies in the suite. This one had adequate as-built information, so field survey was not needed at this time.

It would be helpful to "connect the dots" between the studies of the same areas. For example, the Beltline Feasibility study, pp. 30-31 and Figures 3-11 and 3-12 outlined system modifications to Grass Lake and West Vadnais Lake. Which ones have been done already, which ones are included in this study, and which ones have you rejected, and what are the details as to why?

Clarifying language will be added to the final report.

2.0 Study limitations
Assumptions

Yes, datasets have errors, for example Shoreview's SWMP. I am glad you are using your own sources. I trust you will correct third party datasets as you identify errors.

Yes.

You stated "As the project advances and additional information is uncovered by or made available to us, it may alter the recommendations provided herein." This is particularly important given the RWMWD's and Barr's relatively recent studies of these "complex" areas and additional knowledge to be gained as the recent CIP improvements change the conditions. Please inform the Board as new information alters the recommendations.

Yes.

4.0 Design basis

Please address in this section why no option for using the existing pipe is considered. In section 5.0 you state "A new pipe is required to increase the conveyance capacity of West Vadnais Lake south of I-694 for many of the proposed hydraulic alternatives." Since "many" does not mean "all," what are the alternatives for using the old pipe (e.g. year-round pumping or intermittent pumping) and the reasons they were rejected?

As described at the May board meeting, we did evaluate an option that would leverage the existing 15-inch pipe during an opportunistic pumping scenario. This scenario was not found to provide a significant benefit over existing conditions.

For the changes described in the main body of the report, however, we found that only a new, larger pipe would be able to carry high enough flows out of the system. We think that the cited language is likely there because we did evaluate a pressurized pipe option that could be smaller, but which was later ruled out. Staff will change the wording so as to not convey that other viable alternatives could use a smaller pipe, such as the existing 15-inch pipe.

What are you referring to as RWMWD's "stormwater management preferences?" As stated by Tina at Commissioner Frethem's community meeting, "RWMWD's flood mitigation priorities are habitable structures; roads and local infrastructures; and public lands, open spaces, and parks."

This language refers to the goals of this particular study, as discussed at the May board meeting.

Is it time to revisit the issue of why West Vadnais Lake is in VLAWMO? It is not connected to their watershed; it is wholly within the RWMWD. It does not generate tax revenue. It is polluted. It contributed to flood issues in both the Twin Lake and Grass Lake areas. What happened after the Board directed talking with VLAWMO about this last year?

In past discussions, the board determined that instead of pursuing a boundary change, we would continue to partner with VLAWMO on projects that impact West Vadnais Lake and the RWMWD. Since that time, the EAW was approved for the outlet lowering. VLAWMO provided comments on that project. We have also partnered on West Vadnais Lake carp management, which is a water quality improvement need VLAWMO was willing to pursue ahead of its TMDL. We are in close communication with VLAWMO and its new administrator.

5.0 Pipe alignment alternatives

Figure 2. Show the current pipe alignment.

Okay. This will be added to the final report.

You state that discharging directly into Owasso Basin has some problems. Regarding Alternative 3: Would the new larger capacity pipe segment from Black Tern Pond to Drywall Pond follow the existing pipe's path? What is the current pipe's size? What size is the one in this alternative? Could an additional smaller one be added instead of replacing the current one?

A large factor that guided the alternative pipe alignment evaluation was the ultimate discharge location. Given that Owasso Basin is currently at high risk of flooding homes and structures, routing additional flow into this area was deemed counterproductive. We do acknowledge that the Owasso Basin feasibility study is ongoing, and that the study findings may better inform the design basis utilized for the West Vadnais Lake conveyance under Highway 694 study. (e.g., system improvements to Owasso Basin infrastructure may provide flexibility to increased inflows).

Instead of routing the pipe around Hom Furniture in Alternative 1, with the grade problems it presents, did you consider a variation of 1A and 3 which would use a pipe or ditching from Drywall pond east along the railroad tracks to connect to a new pipe (essentially the remainder of Alternative A to Porky Pond)? Per drawing C-01 it is not far.

The primary alignment of the pipeline follows Country Drive to stay within the public right of way toward the discharge location of Porky Pond. Alignment A-1 was considered and a cost benefit estimated to bypass the corner and cut across the HOM Furniture parking lot. There are cost savings associated with this alignment, with the drawback of crossing private property and obtaining permission or an easement from the property owner. A conveyance ditch east along the railroad tracks as suggested was not

considered. We can look into this further if requested; a preliminary analysis could consider the location of the proposed ditch within the railroad right of way, evaluate existing topography to evaluate the ditch geometry, and evaluate the hydraulics to evaluate the risk posed to the railroad if the ditch capacity is exceeded and localized flooding occurs, potentially weakening the integrity of the rail bed.

1A and 3 alternatives dump into Owasso Basin. Is it possible to route a pipe from Owasso Basin the short distance directly to Porky Pond?

Infrastructure modifications within Owasso Basin were not extensively evaluated given the ongoing Owasso Basin bypass feasibility study. (A focus of this study is evaluating options for protecting at-risk structures.) Constructing a connection point from within Owasso Basin to Porky Pond may be feasible and have some merit, and synergy between this feasibility study and the Owasso Basin study can be evaluated as the Owasso Basin feasibility study wraps up.

Isn't it premature to reject alternatives discharging into Owasso Basin before completing the studies to reduce the flows into the Owasso Basin area, e.g. diverting MNDOT flow? Most of the potential system modifications in the Beltline study would increase flow. Some could be accomplished as CIP projects, e.g. excavation of ponds and increasing culvert capacity. Specifically, is it possible to increase Owasso Basin outflows instead of or in addition to reducing inflow? The Beltline Study 3.1.2 suggested a combination of weir and increased culvert capacity to move more water out of this area.

This feasibility study acknowledges the ongoing Owasso Basin bypass study. As noted in the memo, synergies may exist between the studies' findings to optimize conveyance through or around Owasso Basin. However, at the time of the West Vadnais Lake study, details regarding the potential improvements to Owasso Basin were unknown, and making future assumptions about those study findings would be impractical; the study findings would be based on a "what-if" scenario and not on existing conditions.) As further clarity or definition is provided regarding Owasso Basin modifications, the design basis for the West Vadnais Lake study may be modified to better align with existing or proposed/pending conditions.

It would be helpful to have a short list of pros and cons for each alternative route. For example, the ones using existing infrastructure would presumably be cheaper. Considering the conclusion in 6.0 that the proposed pipeline would prevent Twin Lake and Grass Lake flooding, the amount of time it would take to accomplish this project is a negative factor if something quicker is an option.

The most viable options were presented in the report. However, clarifying language, including pros and cons, can be added to the final report to address these comments. Questions about discharging into Owasso Basin directly are good topics for when the Owasso Basin bypass project will be discussed, as this option would be a link between the two feasibility studies discussed in this set of comments.

6.0 Hydrologic and hydraulic analysis

You say "implementing this new West Vadnais Lake outlet would increase flood elevations in Gervais Lake if implemented before the Phalen chain of lakes control structures are modified to pass more flow on demand." It detracts from a real risk assessment for Lake Gervais residents, wastes our time, and is

confusing, to consider modeling that doesn't not take into account these already planned and budgeted for modifications.

Model results presented in this report do reflect how upstream conditions would look with downstream controls in place. This language is just to clarify that without downstream controls on the Phalen Chain of Lakes, flood levels would increase. The modeling assumes that downstream controls are in place, as guidance from the managers was that flood levels downstream could not increase. The difference is the "opportunistic pumping" scenarios presented in attachment C, which assume that actions could be taken before downstream capacity is increased on the Phalen Chain of Lakes.

Regarding the "conclusions based on modeling," it seems that the modeling continues to use existing high water conditions as a starting point. Is it possible to model the need for this size pipe if West Vadnais Lake comes down to 881, 882 or even 883 as a result of the lowered outlet?

The model runs already assume that in 2014, water levels start at the outlet elevations of all lakes, including Grass Lake and West Vadnais Lake.

Considering the OPC, you need to make a strong case that this expensive project is needed, i.e. that the CIP projects combined with opportunistic or year round pumping would not be enough in the future. It seems that you are saying this project is needed in 9.0, but you don't say why it is the best option.

The report neither recommends nor advises against the changes described in the report, as a decision on this project cannot be made by the managers before discussing the other feasibility studies in progress and prioritizing next steps. The purpose of the report is to show the managers what it would take to achieve the flood management goals laid out in the design basis section of the report.

7.2 Pipe size

Installing a larger pipe does increase flexibility to manage increased precipitation/storm runoff in the future. Given precipitation projections, I am all for going a step up on each project's capacity if feasible. But, if the modeling conclusions change, per above, does your recommendation change?

Modeling conclusions are not expected to change.

Mention the amount of the cost savings here, i.e. 589K, or refer to the cost page.

Okay. This change will be made in the final report.

Other comments:

Please address the potential impact of opportunistic pumping scenarios on the need for and design of the I-694 Conveyance Feasibility Study. Were the effects modeled?

If not, why not? Would the use of opportunistic pumping negate the need for the I-694 conveyance, impact timing, or reduce the costs? At our meeting you said that opportunist pumping would not make a difference. That conclusion and reasons for it, as well as what you consider a "difference" is, should be included in the report in order to give more context to both the feasibility study and the opportunistic pumping section. Also, the model in the Grass Lake chart is being re-run and the expectation is that more benefit will be shown. It seems this could change the conclusion.

Opportunistic pumping, as described at the May board meeting, was meant to address what could be done before downstream changes to the Phalen Chain of Lakes or Owasso Basin bypass are in place and was not intended to be pursued otherwise. It would not negate the need for I-694 conveyance or impact timing.

The Grass Lake chart was rerun as mentioned in the draft report, and in time for the July board meeting. The charts presented there will be included in the final version of the report. The results did not change the conclusion, as discussed at the board meeting.

A better balance in the level of detail would make the report more useful and accessible. More is needed on some things and less on others, e.g.

- More detail on the reasons potential solutions are rejected or recommended
- More detail on benefits vs. risk analysis of each option
- Less detail on permits needed. Permits are already mentioned in 2.0. We all know that a lot will be required and that they can be a hurdle (at least in time). A summary statement would suffice
- Ditto regarding the cone penetration test results. You mention the pertinent facts in the body of the report

We will consider this feedback along with the other managers' comments in finalizing the report, erring on the side of more detail versus less.

Should we hold off on this study and planning until we have at least a full year of evaluating Keller and Phalen weir impact?

That is an option, or we could move forward with studies and planning as the Keller and Phalen weir changes are made, since implementing other projects will take some time anyway.

I discussed improving report writing with Erin before. The reports should be easily understandable, not just by the Board of Managers, but also by our constituents (taxpayers in the district). Again, please:

- Use consistent descriptors. It is hard to tell, but it appears that multiple names are being used for the Phalen and Keller weirs, i.e. "Phalen Chain of Lakes control structures," "Phalen and Keller weirs", "downstream improvements," and "timing constraints." Are these all the same things? If so, use a common descriptor. If not, define them as you go.
- Avoid engineer jargon when possible, e.g. "stochastic."
- Always include page numbers, even in attachments.

We will keep these suggestions in mind as we create the final technical report.

Attachment C: opportunistic pumping scenarios
Background

Board members did not ask you to look at opportunistic pumping "in advance of changes to control structures for the Phalen Chain of lakes." You were asked to look at it this year along with those structures, as planned when the Board adopted the budget last year. All three of these studies were deemed important enough to specifically fund for 2020. We expected that you would have to complete the Keller and Phalen weirs first (logic and the Beltline study). I am disappointed with how long it has taken to get going on these projects, as well as the lack of sequenced planning.

At the May board meeting, managers directed us to evaluate opportunistic pumping in advance of changes to the Phalen Chain of Lakes' control structures and other potential piped changes evaluated, as described in the West Vadnais Lake conveyance south of Highway 694 feasibility study scope. At the same time, under a different project effort, staff are considering what an operations plan for the Keller and Phalen weir changes could look like. Another project, the Owasso Basin bypass study, explored

options for conveying higher flows around Owasso Basin. All of these projects are occurring simultaneously, with plans to implement the changes to the Keller and Phalen weir structures later this year.

You "ran a 6-year simulation…comparing flooding with and without opportunistic pumping…" using past data. That covers past known factors. However, assuming the Keller and Phalen weirs will help lower and manage the whole system, wouldn't it make sense to run simulations taking into account their impact?

The year-round pumping options assume that downstream controls are in place. The opportunistic pumping options were evaluated assuming that they would be pursued in advance of downstream changes in flow capacity (due to larger pipelines and changes to the Keller and Phalen weirs).

I like the stated goals, but their vagueness is a bit concerning, e.g. reducing frequency and volume of flooding and keeping the elevation of West Vadnais Lake as close to 881 as possible. Does that mean it is not possible to prevent flooding or keep the elevation at 881 without the major projects described in the feasibility study?

Yes.

Why would you consider pumping West Vadnais Lake below 881? Is that desirable? If so, please be more specific in your reasons for stating this would not be approved? If not, why mention it?

Pumping West Vadnais Lake below 881.0 would allow for even more flood storage between events; however, this was not evaluated given our experiences with the EAW for lowering the existing 15-inch outlet structure. Pumping below 881.0 would likely cause ecological concern about wetlands and wildlife (particularly Blanding's turtles) in the immediate area. As stated in the background section: "Pumping below a West Vadnais Lake elevation of 881.0 is unlikely to gain support from regulators and VLAWMO; another EAW would likely be needed to target a lower elevation. Based on past experience, VLAWMO and the DNR both seem unlikely to offer support or approval."

What is the basis for the pumping cost estimate of $50,000 per month? How much is set up? What is involved in operating it and what are the costs? Is that estimate based on pumping every day?

This estimate is based on recent pumping projects within the RWMWD, and includes setup, materials, fueling, inspections (both by contractors and RWMWD staff), and maintenance. Daily pumping is assumed, based on modeling results.

Bypass system route. You discussed the maximum flow rate. Did you evaluate something less?

No. We assumed that we would need as high a rate as possible to make significant change.

You rejected the option of pumping to allow the 15-inch pipe to remain full and flowing at 4cfs year round. Define "significant" in your statement: "This scenario was not found to provide a significant benefit over existing conditions." We need to know why this is, in order to reject this option.

The water surface elevations in West Vadnais Lake with and without this option were essentially indistinguishable. We can add those charts to the final report to demonstrate this.

Did you consider options that would make the benefit more significant than the 4cfs by itself, but the risk less than adding an additional 6cfs option?

- Could a pump be added to the existing pipe that would increase the flow to over 4 cfs?

- Is there another in-between option that would move more than 4cfs and less than 10 cfs that would meet the goals? For example, 4cfs from the 15-inch pipe and 4 cfs from the bypass system?

We only looked at scenarios that would keep the pipe flowing full at 4 cfs at lower West Vadnais Lake water levels, in order to be consistent with the memorandum of understanding associated with the existing 15-inch pipe limiting pipe full flow to 4 cfs. We did consider scenarios that would combine leveraging the 15-inch pipe with a flow through the bypass route of less than 6 cfs because the benefit to upstream water levels does not seem to be enough to warrant the pumping in the first place.

Regarding the modeling based on precipitation and infrastructure resulting in lower flood conditions than actually witnessed, is your model wrong? More likely, it was not the precipitation data that didn't perfectly reflect the conditions. The problem was the model did not take into account the large volume of water that flooded north out of Grass Lake, over Gramsie Road and into Wetland A in 2014 raising it several feet, i.e. a large amount of Grass Lake water that was prevented from flowing downstream and didn't raise elevations as it would have. The same problem is present for modeling based on Grass Lake and West Vadnais Lake elevations 2015-2019.

We can't compare past observations of water levels to these model results because the model reflects current (2020) infrastructure conditions with 2014 to 2019 precipitation. The questions we are trying to answer for the managers are: What more should be done, and what effect would these changes have if we see 2014 to 2019 precipitation again in the future? The benefit of modeling in this way is not to try and reproduce past events, but to look ahead at what could be coming next and what we should do about it.

The model in the Grass Lake chart will be updated. Please indicate what impact it has on your recommendations. Will the West Lake Vadnais chart also be updated? The "slightly more benefit" may move into the "significant" range.

The updated Grass Lake chart was presented at the July board meeting and will be incorporated into the final report. The West Vadnais Lake model does not need to be updated. These changes do not alter the recommendations in the report (which are the same as those discussed at the board meeting).

Does the modeling, although using 2014 to 2019 precipitation rates, account for the infrastructure improvements added in late 2018? They have made a difference, and will continue to make even more, especially if properly maintained.

Yes. Infrastructure conditions in the model reflect current conditions. Precipitation conditions reflect 2014 through 2019.

In the section about comparing the 6 cfs emergency bypass pumping, you mention the "second goal above." Don't make us look back 4 pages before. Just say what the goal is.

Okay. This change will be made in the final report.

Is the chart referred to as showing how often the bypass system would be activated mislabeled or is one missing? The next chart lists "Grass Lake" and seems to refer to Goal 1.

The chart is accurately labeled, but perhaps we are misunderstanding this question, as we don't see a subsequent chart labeled "Grass Lake." Goal 1 does pertain to Grass Lake and not West Vadnais Lake directly, but all the goals are presented together in the discussion, as they were in the introduction section.

It seems all goals are substantially met by opportunistic pumping, correct?

It depends on what the managers deem "substantial." All goals are met as described in the report. Whether the benefits of meeting those goals are worth the cost is a board decision.

Opportunistic pumping scenario board proposal from June 2020 meeting

The conclusion in 6.0 of the West Vadnais Lake South of I-694 Feasibility Study, that the proposed pipeline would prevent Twin Lake and Grass Lake flooding, if adopted would be a long term project. Something needs to be done sooner. There are a number of cost effective options that have been discussed. There needs to be more of a commitment to find the best one that will work in the short term, if and until a larger project to protect the area is approved, funded and completed.

The RWMWD has already implemented measures that help prevent Twin Lake flooding, and measures have also been taken in the Grass Lake area. Staff have recommended these projects, which are completed or in the process of being completed.

Will Gervais Lake be lower, i.e. not in the "chronic flooded condition" you used for your analysis, after the Phalen and Keller weirs are installed and have a while to manage downstream flow? How much lower? Or, are you going to use the weirs to drop Gervais when a 100 year storm hits? It would be helpful to know more detail about the operating plan for the weirs.

The operating plan for the Keller and Phalen weirs is currently being developed, and final recommendations are not complete. The board will receive an update at a future board meeting.

Since the two houses on Gervais Lake would flood even with no additional flows from upstream, how much difference would the additional flows make? 0.12 feet (1.44 inches)? That is, would any additional houses be threatened?

No. The next lowest home on Gervais Lake is at a low entry elevation of 862.0 (681 County Road B2). If the flood level were to be raised by 0.12 feet, the 100-year flood elevation on Gervais Lake would be 861.92. Past board guidance on this topic as it pertains to this study, however, has been to not raise downstream flood levels at all.

Did you consider any scenarios pumping less than 6 cfs? Or pumping less volume combined with "pulsing pumping?"

Pulsing pumping was ruled out for the reasons described in attachment C and in the presentation at the July board meeting, given the managers' directive to not raise downstream flood levels on the Phalen Chain of Lakes. Pumping fewer than 6 cfs through the bypass route was not evaluated.

You said "pumping West Vadnais Lake between March and October is not recommended by staff until downstream capacity increases on the Phalen Chain are implemented." Does this mean the Phalen and Keller weirs?

Yes, along with the Owasso Basin bypass pipeline, or some other pipe to carry West Vadnais flows all the way to the Phalen Chain of Lakes.

If so, and you would recommend pumping then, why did you not lay out the options and your recommendation?

If the Keller and Phalen weir changes are in place, and the managers choose to provide a pipeline that can carry higher flows from West Vadnais Lake downstream, a gravity flow pipeline such as the one presented in the main body of the report is the more cost-effective option. We did include some year-

round pumping model results in attachment C, but more to indicate what kinds of flow rates actually make a noticeable difference in lake levels. Clarifying language will be added to the final draft of this report to describe why this information was included in attachment C.

However, we should note that the intent of the opportunistic modeling runs was to lay out the benefits and costs of each option for the managers' consideration. At this time, staff would not recommend pursuing these options, based on the board's goals and direction during previous board meetings.

Year-round pumping scenarios

Again, I do not understand why scenarios of year-round pumping were run without taking into account control structures. Considering modeling that doesn't not take into account these already planned and budgeted for modifications detracts from a real risk assessment for Lake Gervais residents, wastes our time, and is confusing.

These model runs assume that downstream controls are in place, which allow these significant outflows from West Vadnais Lake. This language is included only to remind the reader that the changes discussed in the report should not be implemented before those downstream controls are in place.

If the feasibility study's "implementation of a gravity flow…arch pipe as a secondary outlet from West Vadnais Lake would achieve essentially the same goals as the higher year-round pumping rates as shown here," why are we considering adding the expensive arch pipe project instead of year round pumping?

The year-round pumping evaluations were included to give the managers a sense of what level of pumping actually does make a difference in upstream water surface elevations, since the opportunistic pumping option benefits are relatively small. If year-round pumping were pursued, a need would still exist for a pipe big enough to carry the pumped flow from the lake, and the addition of a pump station would make the overall project cost greater than the gravity flow option. Clarifying language will be added to the final report to describe this.

I look forward to hearing your answers to these questions and understanding your reports better. Thank you.

You are welcome.

Feedback from Manager Swope
Responses in italics

Here are my comments and observations on:

- The Conveyance Study
- The Opportunistic Pumping Evaluation
- The use of the Atlas 14 data set in the Beltline and other evaluations

Since the other Board members seem to have had prior briefings on Atlas 14, you may want to just point me in the right direction on the Atlas 14 questions.

Regarding Atlas 14, we will provide some information here, but please know we can share a lot more detail if the managers desire. NOAA's update to the Atlas 14 precipitation record from TP-40 was a significant change to the watershed community, one that continues to shape flood management throughout the country, especially in Minnesota where precipitation levels during the 100-year event

increased significantly. Please let us know if more background over and above what is presented here would be helpful.

Background

The applicable part of RWMWD rule D: It is the policy of the Board of Managers to:

Encourage water quantity controls to ensure no net increase in the impacts or potential for flooding on or off site and encourage, where practical, controls to address existing flooding problems.

The flood mitigation priorities for the RWMWD are:

- Habitable Structures
- Roads and Infrastructure
- Public Lands, Open Spaces and Parks

The goal of a system to better control the water levels in the area north of I-694 is to achieve all three of these priorities. Habitable structures, primarily in the Twin Lake area, have been mostly addressed by current projects, but the entire area remains vulnerable to environmental damage (degraded Managed A wetlands, Twin Lake water quality, road and property impacts) which need to be addressed to meet the obligations and expectations of the RWMWD to the community.

Control of water in the area north of I-694 is expected achieve the RWMWD's priorities by managing West Vadnais Lake levels so that Grass Lake and Wetland A can be restored from the environmental devastation that has befallen them and so Snail Lake elevations can be better managed. It will also provide a margin of safety for homes and infrastructure like Twin Lake, Crestview, Gramsie Road and Rice Street.

The conveyance study
1.0

The high water levels in this area did not start in 2016, as indicated, but became significant in 2014, although they had been building before then due to inadequate drainage, under engineering and higher levels of precipitation. For historical accuracy (refer to Mark Maloney's presentation in Commissioner Frethem's high water meeting), the reference point for the area north of I-694 should consistently be designated as 2014 in this and subsequent reports.

Okay.

The statement "not increasing flood levels downstream" is an interpretation of Rule D that needs to be clearly defined and agreed to. There are flooding problems north of I-694. The impacts and potential for flooding downstream is not clear as the analysis of "opportunistic pumping" indicates. (See discussion of this later)

For the purposes of this study, Barr assumed that increases in downstream flood elevations were not allowable, per the managers' direction at the May board meeting, before the report was presented for manager review at the July board meeting.

"Barr evaluated alternatives" The primary alternatives discussed in this report are variations on a gravity-drain system. What about other options?

- Moving water into East Vadnais Lake via a water purification facility. This seemed expensive at the time but is less costly than the reviewed systems.

The board of managers ruled out this option due to the high cost of the project, but also because of SPRWS's continued concerns about this option. At the time of the study, SPRWS was uncomfortable with the idea of accepting West Vadnais Lake water into East Vadnais Lake, even with a water purification system. The scope of this feasibility study was to evaluate the implementation of a pump or pipe system that would carry water from West Vadnais Lake to Gervais Creek, under Highway 694.

- Redesigning the current 15 inch pipe to take a higher flow by using active pumping. The pumps could be activated when appropriate and the gravity system used when levels are under control.

  The existing 15-inch pipe cannot be pressurized to accept higher flow rates above what already occurs when the lake level is high and pushes down on the lake inlet; it is not designed to be pressurized for higher flow rates. We did evaluate the effect of keeping it flowing full at all times by pumping into the 15-inch pipe at lower lake levels, but the effect on the water level in West Vadnais Lake was insignificant.

- Using the pathway employed for Twin Lake protection. Lowering West Vadnais Lake would provide protection to Twin Lake indirectly and achieve the goal of keeping it unpolluted.

  This option was evaluated in two ways: as a part of the opportunistic pumping option described in attachment C, and as part of the year-round pumping option (though perhaps not described that way) presented at the end of the attachment. A 6 cfs year-round pumping rate was chosen as one of these year-round pumping alternatives because such a rate could likely be pumped via that route if downstream capacity could be increased on the Phalen Chain of Lakes. Ultimately, a gravity flow option was deemed to be more cost effective; this alternative is presented in the main body of the report.

In the 2020 RWMWD budget approved by the Board of Managers, there is a line item for $1.75 M titled "West Vadnais Lake Off-season Drawdown System." Although there has been some indication that this was a "place holder" the amount and title are too specific for that to be credible. The replacement proposal discussed in this report is 7 times more expensive than the budget and more in line with previous preliminary estimates for this type of system. What did you have in mind when you put this in the budget? It is relevant and should be considered by the Board since they approved the budget.

The placeholder value was a very rough estimate of the cost to install a larger-diameter pipe from the existing outlet, along its current alignment, to the same discharge location as the existing pipe. The cost to "jack" a pipe under I-694 along this alignment is $1.5 to 2 million, confirmed by the study presented last month. The alternative described in the study would route around Owasso Basin and connect to a bypass pipeline, if the managers deem the bypass pipeline feasible.

4.0

"Confirm that low maintenance storm water infrastructure (i.e., gravity-drain pipe) is preferred."

In the past, the RWMWD has typically favored passive, gravity flow projects to actively pumped ones for a number of reasons: maintenance, operating costs, and capital cost. If a gravity pipe system can't get the job done, we look to pumping options, but typically as a second choice. This statement is a nod to past guidance from the RWMWD to use fewer moving, maintenance-heavy parts in a project wherever possible.

I don't recall a discussion of this and alternatives were not presented. If active pumping achieves the same result for less money, the Board should have that opportunity to evaluate alternatives.

Pursuing a pumping option would be significantly more expensive when a gravity flow option could be equally successful.

5.0, 9.0

The consideration of how best (cost and effectiveness) to control water in the area north of I-694 must be considered in conjunction with any modifications to the Owasso Basin area and the Keller and Phalen weirs. Doing an extensive evaluation without these considerations does not give an accurate picture, so I hope you are planning to revisit this proposal in the workshop once the other studies are completed.

The information presented at the July board meeting was meant to be the first in a series of presentations, and was not meant to contain standalone recommendations about additional year-round drainage from West Vadnais Lake without downstream changes. For this reason, very few implementation recommendations were made. The pipe option described in the main body of the report assumes that a larger pipe is in place between Porky Pond and Gervais Creek (the Owasso bypass project that will be described at the board meeting). Discussions at that meeting, as well as board feedback on the technical memo for each feasibility study, will certainly be factored into final recommendations.

7.2

I would like to know under what scenarios a larger pipe would be needed. In other words, what would the world north of I-694 look like when a bigger pipe is required to reset it?

Given that the arch pipe presented in the main body of the report seems to meet study goals, a bigger pipe may not ultimately provide more benefit in lowering West Vadnais Lake levels even more. However, there may be some benefit in the context of the Owasso bypass feasibility study, which will be discussed next. If that is the case, this information will be included in the final draft of the technical report for this feasibility study.

Opportunistic pumping scenarios

To clarify, the purpose of the suggested protocol for pumping during the period of March to November was NOT to have this done BEFORE control structures were put in place(Keller and Phalen weirs) , but to have a protocol ready AFTER the control structure were implemented. A lot of time could have been saved if this had been clarified. Thus, the discussion of the current level of Gervais Lake is not applicable to the requested review. However, the analysis does point out some interesting issues that should be addressed.

As mentioned above, at the May board meeting, managers directed us to evaluate opportunistic pumping in advance of changes to the Phalen Chain of Lakes' control structures and other potential piped changes evaluated as described in the West Vadnais Lake conveyance south of Highway 694 feasibility study scope. This suggested protocol was evaluated the same way. However, concurrently and under a different project effort, staff are considering what an operations plan for the Keller and Phalen weir changes could look like.

Opportunistic pumping is suggested to help lower the levels of water bodies in the area north of I-694 when they reach a stage where there are negative effects to the environment in the area, especially to prepare for a large rain event or ameliorate the consequences of a large rain event (flooding of roadways, destruction of Managed A wetlands, damage to parks and recreation facilities and damage to private property). It is not just to prevent water from moving to areas where it is not supposed to be

(i.e., flowing north from Grass Lake), but to protect valuable infrastructure and environmental assets from the damaging effects of flooding.

The charts and language discussing the changes to flows north from Grass Lake and overflows from West Vadnais Lake are highlighted because they are the main hydraulic issues we are trying to prevent through the presented pumping and piping options.

Estimated costs of pumping: $50,000 per month seems to be substantial given the experience of other pumping projects. I would like more detail on the detail behind these estimates.

As explained above, this amount is consistent with what we have seen during past pumping efforts in the RWMWD and is a function of refueling and system inspection labor (both contractor and staff time), pump and associated materials rental, fuel, etc. This estimate assumes that the pumping is constantly running, which, for the purposes of these evaluations, is reasonable.

The modeling (see Atlas 14 questions) shows that constant pumping at an extra 6 CFS would only add 1.44 inches of water elevation to Gervais Lake, yet if the 100 year rain event happens, Gervais Lake rises about 3.5 feet and floods the lowest house anyway. Given that an emergency plan would be activated for this home, it is not clear that the "additional released water…would add to the flooding of two habitable structures on Carla Lane," because they are going to flood anyway and that the additional water from pumping would result in a "net increase in the impacts or potential for flooding." In fact, even at 858 starting point, it isn't clear that the additional 1.44 inches from opportunistic pumping would have an effect on the responses for protecting the home (activating the emergency plan) and, thus the "intent" of Rule D would be met. The prescriptive absolute prohibition of raising the level of any water body seems to be an over application of Rule D. It would better reflect the intent of Rule D if Goal Number 4 were modified to read: "To not impact the downstream flood potential on Gervais Lake…"

In advance of this particular study, the managers indicated that no downstream increases in flood elevation should be allowed in any of the opportunistic pumping scenarios. Barr followed that guidance. Other year-round pumping scenarios and gravity pipe flow scenarios showed what upstream levels would look like if downstream capacity could be increased (through an operation plan for the Keller and Phalen weir structures and other increases in conveyance capacity).

The comment that "any pumping operations plan between March and October would require adequate forecasting of a large storm event approximately 3 ½ weeks into the future…" really doesn't have a place in a technical report like this devalued the study. It is known that weather forecasting, like flood forecasting, doesn't have that kind of accuracy.

The statement about how far into the future storm events would have to be forecasted was based on the timing of the response and recovery in Gervais Lake to potential flows coming from West Vadnais Lake if the capacity of the Phalen Chain of Lakes is unchanged. Because weather forecasting is not accurate so far in advance, this option is not recommended.

It would be interesting to run the graph of the level on Gervais Lake during and after the 100 year event with and without opportunistic pumping to visually see the magnitude of the effect.

As discussed in the report, the biggest effect is that the peak 100-year flood level in Gervais Lake could be increased by 0.12 feet. At other times during and after the event, the effect would be less than that amount if pumping has ceased at some point. If pumping continues throughout the storm, the levels in Gervais Lake would be 0.12 feet higher at all times during and after the 100-year storm.

The situation of 2014 modeling not reflecting observed conditions indicates the model may not be taking into account certain aspects of the history of the area. The area north of I-694 had been largely dry for decades and when the excess water was trapped in areas like Grass Lake, Wetland A and West Vadnais Lake, the surrounding dry soil was able to absorb enough of the water to reduce many of the consequences, especially in areas of public concern and visibility (this was not true everywhere – See Mark Maloney's presentation). However, since no action was taken to address the areas causing the excess water, the soils remained saturated or flooded and were not able to recover to cope with subsequent high rain events in subsequent years.

The model used in these scenarios was created to reflect current infrastructure conditions under the influence of past precipitation (2014 to 2019). It should not be viewed as a way to reproduce what happened in the past. Other assumptions such as recharge rates, uniform coverage of precipitation, evaporation, and more also affect model results. The purpose of the model runs presented in the report was to observe current conditions (infrastructure and limited groundwater recharge) and evaluate different scenarios using precipitation levels measured from 2014 to 2019. The intention was not to recreate a past situation, but to look forward to what could happen next.

Atlas 14 use

Is the Atlas 14 data set being used Station 80-023S (NOAA Atlas 14, Volume 8, Version 2 Wedell_P? If not, what one is used?

Rainfall depths are from the Saint Paul gage (site ID 21-7377). Prior to selecting a gage, staff reviewed rainfall depths at adjacent gages and locations (latitude-longitude coordinates) in the centroid of the RWMWD as well as the edges. In general, very little variation in precipitation depths exists over the RWMWD. The Saint Paul gage was selected because it is located within the RWMWD boundary, and a rain gage made reproducing the results easier (as opposed to a latitude-longitude coordinate at the centroid of the watershed). In comparison to the Wedell_P gage, the 100-year, four-day rainfall depth at the Saint Paul gage is 0.04 inches larger, and the 100-year, 24-hour depth is 0.05 inches larger at the Saint Paul gage.

Why do we use a 4-day duration storm for our 100-year event instead of a 1 day or 2 day duration? In looking for information I ran across more 1-day events used as a basis

The rainfall duration used is a function of the time of concentration and floodplain storage volume within the watershed. In general, the rainfall duration will be longer than the time of concentration for the subwatershed being evaluated, so that runoff from all portions of the watershed contribute to a location and produce the peak water surface elevations and/or discharges. It is standard practice for hydrologic studies that utilize rainfall-runoff models to evaluate larger watersheds, and good practice to complete a critical duration analysis. This type of evaluation simulates rainfall events of various durations to identify the duration that results in the largest water surface elevations. The four-day event was identified as the critical duration for the watershed.

The 24-hour rainfall distribution is common; the NRCS develops a unit-less distribution that can be applied to smaller drainage areas. For Minnesota, this is the MSE3 distribution; prior to Atlas 14, it was the SCS Type II distribution. The NRCS developed the MSE3 distribution applying a similar methodology, which was used to develop the four-day distribution employed by the RWMWD. The rainfall distribution that we use nests the 100-year intensities of a variety of durations of 100-year events (short durations, such as the 1-hour up to the 96-hour event). In this way, a system that is sensitive to a short burst and a system that is sensitive to a longer storm with more precipitation volume can be modeled using the same nested rainfall distribution. This is a standard engineering practice, and is also why the 24-hour

distribution is so commonly used by developers and for smaller watersheds (i.e., the 24-hour duration doesn't have to be used, but it is longer than the time of concentration for the watershed being evaluated).

What level of rain do we use for the 100-year event, the nominal figure (e.g., 8.28"), the range (6.26" – 11.3"), the low estimate or the high estimate? Do we assume that there is equal rainfall on each of the four days?

We use the fiftieth-percentile estimate for the rainfall (i.e., 8.32 inches at the Saint Paul gage). The range given in Atlas 14 is the 90-percent confidence interval. Atlas 14 precipitation depths are calculated based on a statistical evaluation, so the fiftieth-percentile value is an estimate, and some uncertainty is associated with it. The range of values indicates a 90-percent probability that the "true" value is within the given range. For the Saint Paul gage, the 90-percent confidence interval for the four-day duration event is 6.43 to 10.8 inches.

The RWMWD completed an evaluation of the upper and lower bounds for the 100-year precipitation depths and mapped the corresponding floodplain throughout the RWMWD to illustrate the uncertainty associated with the 100-year floodplain depths.

How do actual water body depth changes correlate to the outcome of the model (in other words, what is the uncertainty in the model outcomes in plus or minus feet). This isn't clear to me from the validation presentation.

Model uncertainty will vary throughout the RWMWD. In addition to the hydrologic response of the watershed, and routing through storm sewers, model results can deviate from observed water levels if stormwater systems are not properly maintained or partially plugged during an event. In general, when we validate a model, we want to be within approximately 0.5 to 1.0 feet of anecdotal information, and 0.5 to 0.1 feet when survey information is available. We anticipate these differences to be higher if only discharge information is available (and no measured water levels). Table 2-5 in the model validation memo indicates that the RWMWD's model is well within these ranges. However, because uncertainty can vary throughout the watershed, and can be very localized, it is standard practice to use the model as a planning tool to identify flood-prone areas, and then collect additional information such as survey information and water levels to refine the model for specific studies and design.

Is the 2011 Lidar data still valid for areas that have been impacted by prolonged high water?

Yes. However, during the feasibility study phase, surveys are conducted to verify elevations in critical areas due to concern about the error involved in the LiDAR data itself, and not so much about changes due to prolonged high water.

Are the 100 year rain events modeled based on rain consistently occurring throughout the district (everybody gets 8.28 inches), or just in the area being evaluated. Given the extreme variability of rainfall over relatively short distances, the selection of areas could affect the effects and restoration of flood damages.

This is true; we do assume that rain is occurring the same way across the RWMWD when evaluating design storms such as the 100-year event. This is a standard engineering practice. However, when considering a real storm event, we sometime use gage-specific data across large areas. For design purposes, the assumption of consistent rain across a watershed is standard because we often cannot justify assuming how precipitation may vary from storm to storm.

Thank you for your responses to these issues. I'm sure there will be more questions as we proceed through this process and take action on the needs of the RWMWD area. I look forward to the workshop.

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You are welcome.