ACCESS & USE PERMIT AGREEMENT

This **ACCESS & USE PERMIT AGREEMENT** ("Agreement") is entered, as the date set forth on the City's signature page below (the "Effective Date"), by and between the **CITY AND COUNTY OF DENVER**, a home rule city and municipal corporation (the "City") and **DEPARTMENT OF TRANSPORTATION, STATE OF COLORADO** (the "**CDOT**") whose address is Eisenhower Tunnel, P.O. Box 397, Idaho Springs CO 80452.

RECITALS

A. CDOT wishes, in conjunction with Colorado State University ("CSU"), to conduct a study within City-owned property under the jurisdiction of the Denver Department of Parks and Recreation ("DPR") and located within Summit Lake Park (the "Park"). For purposes of this Agreement, CSU shall be considered and referred to as CDOT's consultant.

B. There is concern that the hydrologic regime of the Summit Lake wetland complex east of State Highway 5 has been significantly altered by development of the roadway. The purpose and scope of the study is to investigate the interaction between the natural hydrologic processes upgradient from the road, and the roadway across alpine wetland ecosystems, to determine the road effects on downgradient hydrologic regime, soils, soil temperature and permafrost, and vegetation (the "Study").

C. In order to conduct the Study, CDOT's consultant, CSU, will investigate road designs in other frost-heave/permafrost/alpine tundra areas needs to install; analyze the hydrologic regime and associated soil and vegetation types of the wetland complex adjacent to SH 5 within Summit Lake Park; provide recommendations to improve or restore wetland hydrology and ecosystem function within the Summit Lake Park area; and in consultation with the CDOT study panel, summarize and report all findings and recommendations to CDOT and other interested stakeholders.

D. The scope of the Study, proposed tasks, deliverables, Study schedule, depiction of the study location within the Park and the consultants' curriculum vitae, and the Supplement to the Scope of Study are set forth in **Exhibit A** to this Agreement, which is incorporated in this Agreement by this reference ("Study Scope" and/or the "Study Area").

D. The City concurs with this proposed Study and the Study can be performed with minimal inconvenience to the users of the Park, including but not limited to the Parks maintenance staff, and the Park shall be satisfactorily restored or repaired, as prescribed by DPR, following the Study ("Restoration").

E. By this Agreement, the City grants a permit for the access and use of the Park for the Study and long-term access and use of the Study Area, as approved by DPR, including for repair and restoration of the area.

NOW, THEREFORE, in consideration of the above premises and the terms and conditions of this Agreement as set out below, the City and CDOT agree as follows:

1. PERMIT. CDOT and its officers, directors, employees, representatives, agents, consultants and contractors (hereinafter referred to collectively as "CDOT") are hereby permitted access onto, and the use of, the Study Area for conducting of the Study within the Study Area as set forth and depicted in **Exhibit A**, including Restoration of the Study Area and other Park areas and other City property that may be affected by the Study.

CDOT acknowledges, concedes and agrees that the exercise of the rights shall be in accordance with, and subject to, the terms and conditions set forth in this Agreement and the statements and representations made by CDOT and its consultant in **Exhibit A**, but only to the extent **Exhibit A** is consistent with the terms and conditions of this Agreement. This Agreement does not authorize CDOT to enter upon, or make any use of, any property other than the Study Area and for only those purposes identified in **Exhibit A** and this Agreement. These rights and obligations are not transferable and are non-exclusive.

2. CITY RETAINED RIGHTS. The City retains the right to use, occupy, enjoy, grant other interests, and in all other ways govern and control the Study Area and any City-owned property and right-of-way so long as such City activity does not substantially impair CDOT's rights as granted herein. Notwithstanding the foregoing, the City, acting through its DPR Executive Director, retains the right, at the DPR Executive Director's sole discretion, to require CDOT to remove the Personal Property from the Study Area at no cost to the City. The City retains the right to monitor and establish procedures applicable to CDOT's use of the Study Area. The City retains the right, at the DPR Executive Director's sole discretion, to impose and require additional terms or conditions, including charging to CDOT costs or expenses incurred by the City, should CDOT fail to comply with this Agreement and the DPR Executive Director does not elect to revoke this Agreement as provided below.

3. FEE; COSTS. There is no fee for the Permit. CDOT or such other party as determined by CDOT, but not the City, shall be liable for all costs and expenses associated with the Study, Restoration, and other operation permitted under this Agreement.

4. BASIC TERMS & CONDITIONS.

A. Compliance with Laws. If applicable, CDOT shall obtain, keep in effect, comply with, and provide copies to DPR, as directed, all notices, permits, licenses, consents, permissions, and approvals required by any governmental or quasi-governmental entity prior to commencing the Study or any other operations within the Study Area and the Park. CDOT hereby acknowledges that, if required by DPR, City or Clear Creek County, and before conducting any and all activity on or about the Study Area. Any required manifest, approval, license or permit shall be issued in CDOT's name. CDOT shall not be required to obtain a Temporary Construction Access Permit for any operations performed, including Restoration.

B. No Property Interest. Nothing in this Permit creates or recognizes a property interest on the part of CDOT in or to the Study Area or any other City-owned property.

C. Revocation. The DPR Executive Director shall have the right, at the DPR Executive Director's sole discretion, to revoke or suspend the rights granted under this Agreement at any time and for any reason. If necessary, the DPR Executive Director will give CDOT a Notice of Revocation ("Notice"). If the reason for the Notice is for a curable violation of this Agreement, as determined by the DPR Executive Director, upon receipt of such Notice, CDOT shall have thirty (30) calendar days, or such longer time as specified by the DPR Executive Director, to cure the violation and to demonstrate to the satisfaction of the DPR Executive Director that the violation has been cured. If the reason for the Notice is not curable, as determined by the DPR Executive Director, CDOT shall have ninety (90) calendar days to remove its Study equipment, materials, personal property and all its appurtenances from the Study Area and restore the Study Area as required herein.

D. City Representative. A DPR Representative will be assigned to be CDOT's contact for coordination and oversight of the Study and Restoration work and related activities of CDOT under this Agreement, notifications under this Agreement, and in the event of an emergency. The DPR Representative may be changed or other representative added at any time upon notice to CDOT.

E. Direction by DPR Representative. CDOT shall promptly update and inform the DPR Representative of any changes or modification of any Study schedules, plans and protocols or Restoration work. CDOT shall provide prior written notice to the DPR Representative before accessing the Park to initiate the Study. CDOT shall take all reasonable measures to keep the DPR Representative informed of the progress of the Study, including Restoration, and other operations and any related activities, and any emergencies, in accordance with this Agreement and **Exhibit A**, and to comply with the directions and requirements of the DPR Representative, including any order to suspend work or to cease and desist in any unauthorized activities. The Restoration and related work shall be performed to the reasonable satisfaction of the DPR Representative.

E. Consultants; Contractors. All contractors, subcontractors, consultants, suppliers, laborers and agents retained or authorized by CDOT to perform the Study, Restoration, or other operations or to undertake any activities on or about the Study Area or other City property, including any subconsultants to CSU shall be regarded as being "CDOT" under this Agreement, shall be subject to the terms and conditions of this Agreement. Any contractors retained to perform the Restoration shall be identified (by name, address, telephone number, and email address) in a prior written notice to the DPR Representative, and that information shall be updated as needed. At no time shall CDOT, its officials, employees,

contractors, subcontractors, consultants, suppliers, laborers or agents be regarded as working for the City in any capacity nor shall they be regarded in any manner as being employees or contractors of the City.

F. Liability for Damages. Except as may be limited by the Colorado Governmental Immunity Act and Colorado indemnity laws, CDOT shall be solely responsible for all compensation or restitution for injuries to persons or damage to or loss of property belonging to persons arising from, or related to CDOT's and its consultant's and contractor's own actions or omission related to the Study, Restoration or other operations or work or other actions of CDOT involving equipment, materials or personal property owned or leased by CDOT or its consultants or contractors, or other City-owned property. The term "persons" shall include, without limitation, City officials, employees, volunteers, consultants, contractors, tenants and agents. Otherwise, neither party to this Agreement shall be required to indemnify or hold harmless the other.

G. Restoration. Except as detailed in **Exhibit A** and this Agreement, CDOT shall not damage, destroy or harm any part of the Park on or about the Study Area or other City-owned property and shall promptly repair, replace or restore said damaged, destroyed or harmed areas of the Park, to the satisfaction of the DPR Representative, to a condition similar to or better than that which existed prior to the commencement of the Study.

H. Utilities. CDOT shall be solely responsible for locating and taking appropriate measures to protect all utilities, including without limitation gas, electrical, sewer, water, telephone, and cable, during the Study, Restoration, or other operations and related activities on or about the Study Area or other City-owned property. CDOT shall arrange for the timely and complete location of all utilities in accordance with law; shall take all necessary precautions to avoid damage to, or injury from, such utilities; and shall be liable for all damages resulting from any contact with or destruction of such utilities. The DPR Representative will provide, upon request, any drawings or other documents the City may have regarding the existence of such utilities on or about the Study Area or other City property, but the City expressly disclaims the reliability or accuracy of any such drawings or documents it may provide to CDOT.

I. Emergency. Written notice requirements are waived in the event of any emergency situation requiring immediate access or activities on or about the Study Area or other City property, such as a major on-site accident, contamination exposure, utility damage, and security breaches. In the event of such an emergency, CDOT shall provide verbal notice to the DPR Representative as soon as feasible (or, if the DPR Representative is not available after three tries within eight (8) hours, call 311 and leave a message regarding the nature of the emergency and contact information) and then follow up with written notice to the DPR Representative within twenty-four (24) hours of such emergency. CDOT shall be responsible for timely notifying and cooperating with the appropriate

governmental authorities, as required by law, in the event of an emergency. The City shall have the right to instruct CDOT's actions regarding the emergency response on the City Property.

J. Personal Property. No equipment, materials, vehicles, temporary structures, chemicals, signs, barriers, or supplies brought on site or generated by CDOT on site ("Personal Property") shall be stored outside of the Study Area. CDOT shall be solely responsible for securing its Personal Property from public access or tampering and for the protection of public health and environment. The City assumes no liability for public misconduct, theft or vandalism of the Personal Property. Upon the completion of any work, CDOT shall promptly remove from the Study Area all Personal Property. Alternatively, if CDOT should fail to remove the Personal Property as provided herein, the City may perform such removal and the City shall not be responsible for the condition of the Personal Property if such removal is performed. CDOT shall allow any waste, trash, or debris generated by the Study or Restoration to remain on the Study Area for an unreasonable length of time during any part of the Study or Restoration.

K. Environmental Requirements.

(1) Hazardous Materials. With respect to CDOT's use of the Study Area under this Agreement, CDOT accepts the Study Area "as is," with all existing physical and environmental conditions. CDOT shall be solely liable for all costs and expenses associated with any Hazardous Materials, as defined below, that CDOT brings onto the Study Area or that are exposed or otherwise requiring remedial action as a consequence of the Study, Restoration or other operations. CDOT shall comply with all environmental requirements ("**Environmental Requirements**"), including but not limited to Environmental Requirements regarding the storage, use, transportation, and disposal of Hazardous Materials and regarding releases or threatened releases of Hazardous Materials to the environment. The term "**Hazardous Materials**" shall mean asbestos, asbestos-contaminated soils, and asbestos-containing materials, special wastes, polychlorinated biphenyls (PCBs), any petroleum products, natural gas, radioactive source material, pesticides, any hazardous waste as defined at 42 U.S.C. § 6903(5) of the Solid Waste Disposal Act, any hazardous substance as defined at 42 U.S.C. § 9601(14) of the Comprehensive Environmental Response, Compensation and Liability Act, and chemical substance as defined at 15 U.S.C.§ 2602(2) of the Toxic Substances Control Act, and any guidelines issued and rules or regulations promulgated pursuant to such statutes, or any other applicable federal or state statute. The obligations set out in this paragraph shall survive the expiration or revocation of this Agreement.

(2) CDOT Responsibility and Liability. Except as may be limited by the Colorado Governmental Immunity Act and Colorado indemnity laws, and as related to its own actions or omissions, CDOT shall (i) assume all liability for proper manifesting and management of all waste and, in particular, Hazardous

Materials generated or uncovered by CDOT in the course of the work or related activities; (ii) use best efforts to minimize the volume of Hazardous Materials associated with the work or related activities on or about the Study Area, and shall properly and lawfully handle, containerize, manage and lawfully dispose of all such Hazardous Materials and other waste; (iii) will not take any action with respect to such Hazardous Materials that may cause any alteration in the chemical, physical or biologic nature or characteristics of the Hazardous Materials while the Hazardous Materials are on or about the Study Area; and (iv) remove all Hazardous Materials and other waste associated with the work or related activities from the Study Area. All such environmental obligations stated above for the Study and Restoration work shall be completed promptly upon completion of the Study. The City shall not own or be responsible for and does not take legal title to any of the Hazardous Materials and other waste associated with the work.

(3) Soils Management. Soil excavated during the Study or Restoration which contains Hazardous Materials must be removed from the Park or other City property and legally disposed specified above. Excavated soil which does not contain Hazardous Materials or other waste may be reused as backfill or re-grading on the City property during Restoration provided there are no field indications of contamination such as odors, staining, or organic vapor meter readings above background. Otherwise, if any soil is brought on the City Property by CDOT for fill or grading purposes during Restoration, then the soil must be free of Hazardous Materials and other waste. Determinations as to the existence of Hazardous Materials and other waste shall be made by the DPR Representative in consultation with the City's Department of Public Health and Environment.

(4) City Property. CDOT is prohibited from bringing or exposing Hazardous Materials on any City property during the Study, Restoration, or other operations, or any other activity associated with this Agreement, but if CDOT should violate this prohibition, CDOT shall be subject to the provisions of this sub-section 4.K. and any requirements and directives of the City's Department of Public Health and Environment and other federal and state agencies and shall be solely liable for any costs and expenses for remedial actions and damages.

5. SPECIAL CONDITIONS OF ACCESS & USE. In addition to all other general terms and conditions set forth in this Agreement, the following terms and conditions are established.

A. Access/Traffic Control. In the event that the Study, Restoration or other operations or work shall require that portions of any bike/pedestrian trail or access to any facility or parking lot be closed for more than twenty-four (24) continuous hours, CDOT shall prepare a detour plan which must be approved by the DPR Representative prior to CDOT implementing the detour plan ("Traffic Control"). All Traffic Control measures, including barricades, signs, and flagging, are subject to changes required by the DPR Representative if the DPR Representative finds any of them to be inadequate.

B. Trees. Any trees located within or in the vicinity of the Study Area must be appropriately and sufficiently protected by CDOT from the Installation, Restoration, and Operation work to be performed within the Study Area. Protection, which may include fencing or barriers around the trees, must be approved by the DPR Representative and installed prior to the start of the Installation, Restoration or Operation work. CDOT shall be liable for the loss of or damage to any trees and/or costs of replacing any damaged trees.

6. **INSURANCE**. CDOT is a "public entity" within the meaning of the Colorado Governmental Immunity Act, §24-10-101, *et seq.,* C.R.S., as amended ("Act"). CDOT shall maintain insurance, by commercial policy or self-insurance, as is necessary to meet the its liabilities under the Act. Proof of such insurance shall be provided only upon request by the City.

7. Nothing in this Agreement shall be construed as a waiver of the notice requirements, defenses, immunities and limitations the Parties may have under the Colorado Governmental Immunity Act (§24-10-101, C.R.S., et. seq.) or to any other defenses, immunities, or limitations of liability available to the Parties against third parties by law.

8. **REMEDIES AND VENUE**. The Parties shall have all remedies available at law or in equity against the other. Venue for any action under this Agreement shall be in the District Court for the City and County of Denver.

9. **GOVERNMENTAL APPROVALS AND CHARGES**. CDOT shall obtain and maintain, at its sole cost, and comply with all permits or licenses required for the work to be performed under this Agreement. CDOT shall be responsible for any taxes, fees, costs and charges of whatever nature applicable to the work and shall not permit any of said taxes, excises or license or permit fees to become delinquent or to fail to pay any penalties or fines assessed with respect to the work. The City shall not be liable for the payment of fees, charges, taxes, late charges, penalties or fines of any nature related to the work. CDOT shall promptly pay when due, all taxes, bills, debts and obligations it incurs performing the work under this Agreement and shall not allow any lien, mortgage, judgment or execution to be filed against City property.

10. **GOVERNMENTAL IMMUNITY**. Nothing in any other provision of this Agreement shall be construed as a waiver of the notice requirements, defenses, immunities and limitations the City may have under the Colorado Governmental Immunity Act (§24-10-101, C.R. S., et. seq.) or to any other defenses, immunities, or limitations of liability available to the City against third parties by law.

11. **NO DISCRIMINATION IN EMPLOYMENT**. In connection with the performance of the work under this Agreement, CDOT agrees not to refuse to hire, discharge, promote or demote, or to discriminate in matters of compensation against any person otherwise qualified, solely because of race, color, religion, national origin, gender, gender identity or gender expression, age, military status, sexual orientation, gender variance, marital

status, or physical or mental disability; and CDOT further agrees to insert the foregoing provision in all approved contracts and subcontracts hereunder.

12. **NOTICES**. All notices required to be given to the City or CDOT hereunder shall be in writing and provided by personal delivery or sent by certified mail, return receipt requested, to:

City: Executive Director
Department of Parks and Recreation
201 West Colfax Ave., Dept. 601
Denver, Colorado 80202

with copies to the DPR Representative.

CDOT: as noted in the first paragraph of this Agreement above, with a copy to the representative appointed by CDOT.

Either party hereto may designate in writing from time to time the address of substitute or supplementary persons within the State of Colorado to receive such notices. The effective date of service of any such notice shall be the date such notice is mailed or delivered to CDOT or the City. Daily communications and coordination between the DPR Representative and the representative of CDOT and its contractor may be telephone or email, if so allowed under this Agreement and as agreed by these representatives.

13. **ENTIRE AGREEMENT**. This Agreement, including the exhibits which are hereby incorporated into this Agreement by reference, constitutes the entire agreement of the parties. The parties agree there have been no representations, oral or written, other than those contained herein and that the various promises and covenants contained herein are mutually agreed upon and are in consideration for one another.

14. **SEVERABILITY**. If any term or provision of this Agreement is held by a court of law (following all legal rights of appeal or the expiration of time therefore) to be illegal or unenforceable or in conflict with any law of the State of Colorado or the City Charter or City ordinance, the validity of the remaining portions or provisions shall not be affected, and the rights and obligations of the Parties shall be construed and enforced as if the Agreement did not contain the particular term or provision held to be invalid; provided, however, if the invalidated term or provision was a critical or material consideration of either Party in entering this Agreement, the Parties shall work together, in good faith, to come up with an amendment to this Agreement that substantially satisfies the previously intended consideration while being in compliance with applicable law and the judgment of the court.

15. **AMENDMENT**. Except as otherwise expressly provided in this Agreement, this Agreement may be amended, modified, or changed, in whole or in part, only by written agreement executed by the parties in the same manner as this Agreement.

16. **NO ASSIGNMENT**. CDOT shall not assign its rights or delegate its duties hereunder, with the exception of contracting and subcontracting as provided in this Agreement, without the prior written consent of the City.

17. **AUTHORITY TO EXECUTE**. The person signing for CDOT warrants that he or she has the complete authority to sign on behalf of and bind CDOT.

18. **ELECTRONIC SIGNATURES AND ELECTRONIC RECORDS**. CDOT consents to the use of electronic signatures by the City. The Agreement, and any other documents requiring a signature hereunder, may be signed electronically by the City in the manner specified by the City. The Parties agree not to deny the legal effect or enforceability of the Agreement solely because it is in electronic form or because an electronic record was used in its formation. The Parties agree not to object to the admissibility of the Agreement in the form of an electronic record, or a paper copy of an electronic document, or a paper copy of a document bearing an electronic signature, on the ground that it is an electronic record or electronic signature or that it is not in its original form or is not an original.

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SIGNATURE BLOCKS BEGIN ON NEXT PAGE.]

Contract Control Number:

IN WITNESS WHEREOF, the parties have set their hands and affixed their seals at Denver, Colorado as of

SEAL

CITY AND COUNTY OF DENVER

ATTEST:

By_____

_____

APPROVED AS TO FORM:

REGISTERED AND COUNTERSIGNED:

By_____

By_____

By_____

Contract Control Number: PARKS-201841483-00

Contractor Name: Colorado Department of Transportation

By: _____

Name: Stephen Hawelson
(please print)

Title: Region 1 West Program Engineer
(please print)

ATTEST: [if required]

By: _____

Name: _____
(please print)

Title: _____
(please print)

SUMMIT LAKE WETLAND STUDY

Dr. David J. Cooper, Senior Research Scientist/Professor
Department of Forest and Rangeland Stewardship, Colorado State University, Fort Collins, CO 80523
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INTRODUCTION

There is concern that the hydrologic regime of the Summit Lake wetland complex east of State Highway 5 (SH 5) has been significantly altered by development of the roadway. Prior to the road construction, surface and groundwater flow to the Summit Lake Flats would have followed the valley topography (Figure 1). Sheetflow and shallow groundwater from the flanks of the surrounding peaks provide diffuse inputs along the length of the complex, in addition to Summit Lake outflows and groundwater movement along the main valley axis. Under current conditions, impermeable road embankments and inboard ditches can intercept and reroute surface and shallow ground water along the roadway, and pass the water under the highway in several culvert crossings. These flow path alterations may have concentrated the formerly uniform distribution of water into discrete flow paths below culvert crossings, while areas not receiving inputs from culvert outfalls may have become drier in the decades since the road was built. The expected impacts of a changing climate such as reduced winter snowpack, higher summer evapotranspiration rates, and an extended growing season could exacerbate the effects of these hydrologic modifications, and potentially damage the rare alpine wetland ecosystems downstream.

OBJECTIVES

The objectives of this study are to investigate the interaction between the natural hydrologic processes upgradient from the road, and the roadway across alpine wetland ecosystems, to determine the road effects on downgradient hydrologic regime, soils, soil temperature and permafrost, and vegetation. Long-term goals of this research are to:

(1) Identify options for road reconstruction to minimize permafrost and hydrologic impacts on such roadways.

(2) Minimize or restore impacts to alpine wetland ecosystems in the Summit Lake Park area that may be caused by the roadway.

To accomplish these objectives, we propose the following tasks:

Task 1: Investigate road designs in other frost-heave/permafrost/alpine tundra areas to find relevant roadway designs that are resistant to frost heave and permafrost thawing, and that minimize potential hydrologic alterations to surrounding wetland ecosystems.

Task 2: Analyze the hydrologic regime and associated soil and vegetation types of the wetland complex adjacent to SH 5 within Summit Lake Park, to understand the effects of hydrologic variation on alpine wetlands in the central Rocky Mountains.

Task 3: Identify past and current impacts to wetland ecosystems within Summit Lake Park caused by hydrologic alterations from SH 5.

Task 4: Provide recommendations to improve or restore wetland hydrology and ecosystem function within the Summit Lake Park area that could be implemented in a future road reconstruction project.

Task 5: In consultation with the CDOT study panel, summarize and report all findings and recommendations to CDOT and other interested stakeholders.

TECHNICAL APPROACH

Task 1: We will review studies and reports from areas such as CDOT Region 1, and the states of Alaska and Maine that relate to mitigation of frost-heave and permafrost thawing on roadway integrity, as well as alternative designs that can minimize hydrologic disruptions to surrounding ecosystems. We will include the documents already referenced by the CDOT Librarian, as well as any other relevant literature that is available. The review will summarize the primary processes by which roadways are damaged due to frost-heave and permafrost thawing, and how roadway features can modify local hydrology in alpine settings. We will also describe design features for mitigating road damage and hydrologic disruptions that have been effective in other regions.

Task 2: We will install a network of 40-60 wells shallow groundwater monitoring wells to characterize water table depth and dynamics across the Summit Lake Park wetland complex (Figure 1). Groundwater levels will be continuously monitored in 11 of these wells using automated data loggers. Water levels in the other wells will be measured manually at least bimonthly, during two growing seasons (2018-2019). Monitoring wells will be distributed throughout the study area to capture the range of soil types and topographic settings, and will include ‘reference’ sites on the upgradient side of SH 5 and the potentially impacted area below the road. In addition to recording groundwater depth, the automated data loggers will record water temperature, so we can assess any spatial differences in the thermal regime of Summit Lake Park wetlands. The location and elevation of each well, and the water levels in each well, will be surveyed using local bench marks so that we can create flow nets showing ground water flow directions, features that interrupt flow, and the spatially explicit water table depth across the study area.

At each monitoring well location, we will characterize soil properties and establish vegetation plots. Soil properties will include soil thickness and stratigraphy, organic matter and organic carbon content, water chemistry variables such as pH, EC and ion concentrations, as well as the presence of permafrost or seasonal frost. The abundance and cover of all plant species will be recorded in 1 m radius plots around each well. We will quantify the relationships of vegetation composition to hydrologic, soil and chemical variables using multivariate statistics. We will also analyze relationships between the presence rare plant species such as leafy stem saxifrage (*Saxifraga foliolosa*), ice grass (*Phippsia algida*), and Iceland purslane (*Koenigia islandica*), and key components of the hydrologic regime. These may include the mean and maximum groundwater depth and temperature, and the rate of groundwater decline throughout the growing season.

Task 3: Differences in hydrologic regime and vegetation potentially caused by SH 5 will be identified using data collected from Task 2, and a tracer experiment to document hydrologic flow paths associated with the roadway, and the identification of organic soils in areas that do not have a water table depth and duration suitable for supporting such soils.

Spatial variation in hydrologic regime components (e.g. mean groundwater depth), soils, and vegetation measured in Task 2 can provide insights on longer term effects. For example, deeper water table surfaces and faster groundwater declines in plots below the road, after accounting for related factors such as ground slope and aspect, could indicate that SH 5 is diverting or impeding groundwater flow to portions of the Summit Lake Park wetland complex. The presence of peat soil in areas that do not currently support peatland vegetation and shallow groundwater would indicate former wetland areas that have been dewatered.

We will perform a series of field tracer experiments in the well transects established during Task 2 to document any alteration to groundwater flow paths near SH 5. Bromide or fluorescent dye tracers will be injected into wells above the road, and tracer concentrations will be monitored in downstream wells and exfiltrated surface water in roadside ditches. This approach will allow us to quantify the rates and pathways of water movement across the SH 5 corridor. Significant alteration of hydrologic flow paths associated with SH 5 would be apparent if tracer plumes failed to appear in transect positions below the road. We would also be able to follow tracer plumes throughout the site, and identify areas that receive elevated runoff from culvert outfalls. These tracers have low or negligible environmental toxicity, and have been used to investigate fen hydrology in other regions. The final selection of suitable tracers will depend on initial laboratory testing using soil samples, and approval of project stakeholders.

Task 4: We will integrate roadway design concepts identified through Task 1 with site-specific data collected during Tasks 2 and 3 to develop specific recommendations to improve or restore hydrologic function within Summit Lake Park wetlands. For example, if groundwater interception along the roadway is found to be a significant source of impairment, a porous road base layer may mitigate current impacts. Conversely, if subsurface hydrology is relatively unimpacted by the road corridor but sheetflow concentration below culvert outfalls reduces late summer water availability, increased culvert density may be a viable solution. We will also identify areas where opportunities for wetland restoration exist, based on data from Tasks 2 and

3. Dewatered former wetlands, indicated by relict peat soils or reduced wetland vegetation abundance, may be restored by reducing hydrologic disruptions along the roadway.

Task 5: After consultation with the CDOT study panel for document review and feedback, we will prepare and provide a final report and presentation to the research study panel and other interested parties. At least one peer-reviewed scientific journal article will be published from this work, so that the findings of this project can support improved management and understanding of alpine wetlands elsewhere.

DELIVERABLES

We will deliver the following products and services:

Quarterly progress reports: Will be in Word format via e-mail to the CDOT research study manager documenting progress made on each task and significant events. These reports will be prepared in accordance with CDOT Research branch requirements and are due on the 15th following the end of each calendar quarter (April, July, October & January 15th). The PI shall immediately report to the CDOT Study Manager any problem(s) that may delay the completion of the research work according to the proposed schedule for prompt resolution. These reports will be delivered with any invoice and should be correlated with each other.

Annual Updates and Meetings: Annual update meetings and detailed progress reports will be delivered, and additional meetings may be scheduled as necessary to address any issues that may arise.

Meeting minutes of all meetings held: The PI shall take all the meeting minutes and forward them to the CDOT Study Manager for distribution to the study panel members and other stakeholders identified by CDOT. Meetings with the study panel will be used for the following tasks: discussion of project-related issues, particularly any alterations to the research approach; project review and progress discussions; and to seek guidance and direction in performing the various tasks included in this scope of work.

Draft and Final Research Report: A final report summarizing the research approach, observations, results, findings, and recommendations will be provided. This report will be prepared in accordance with CDOT Research Report Branch Reporting Requirements. The Draft Report shall be submitted in Word format at least 75 calendar days before the contract expiration date. The PI shall submit to the CDOT Study Manager one set of copies of all electronic files, photographs, and data generated for the project on compact disc(s) at the close of the study. All information and materials generated by the selected PI as part of the study shall become the property of CDOT. The following items will be included in the report:

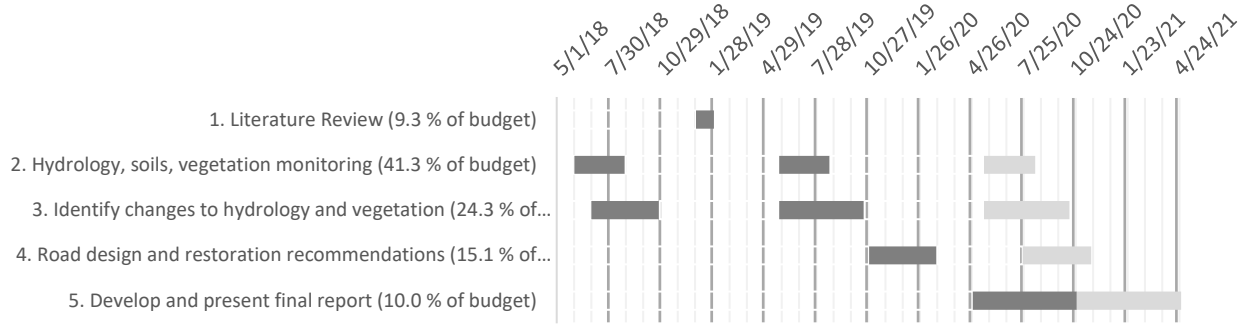
CDOT Implementation Plan: The report will make recommendations as to how CDOT can implement research findings, incorporating lessons learned from this study and literature review. This may include training, presentations, specification changes, process changes, etc.

QA/QC: Prior to delivery of any progress, draft, or final report, PI shall ensure that a proper QA/QC (Quality Assurance and Quality Control) process has been conducted for content, consistency, and editorial issues.

Final Presentation: At the completion of the study, the PI shall give a final presentation to the CDOT study panel members and other interested parties invited by the CDOT Study Manager. The presentation will include slides in a PowerPoint format that is appropriate for presentations to CDOT management, Federal Highway Administration (FHWA), the Transportation Research Board (TRB), and other national and state venues. The PI will provide a copy of the PowerPoint presentation to CDOT on compact disc or other media

PERIOD OF PERFORMANCE

The time required for data collection, analysis, and reporting is approximately 2.5 years from the date of study initiation, assumed to be during May 2018. We also followed CDOT recommendations to include an additional 0.5 years to account for unforeseen delays, making the total period of performance 3 years. A timeline and percentage of budget allocated to each task is shown below. Dark grey bars show expected timing of tasks, while light grey bars indicate timing of tasks if delays are incurred.



COST PROPOSAL

	Rate	Amount	Cost
Personnel			
Salary*			
Cooper	$10,000/mo	0.84 mo	$8,677
Shaw	$5,465/mo	6.5 mo	$36,852
Technician	$3,500/mo	1.75 mo	$6,230
Fringe**			
Cooper	28.1 %		$1,477
Shaw	28.1 %		$11,436
Technician	26.5 %		$1,659
Travel*			
12 trips from Fort Collins to Mt Evans, 14 nights lodging near Mt Evans			$3,669
Materials			
PVC pipe and fittings for wells	$4 each	50	$200
Sodium Bromide for tracer study	$150		$150
Bromide Sensor for tracer study	$800 each	1	$800
Water level loggers	$350 each	11	$3,850
Total Direct Cost			$75,000
Total Indirect Cost	20 %		$15,000
TOTAL			$90,000

* Includes 4 % inflation.
** Includes 0.5 % fringe rate inflation.

APPENDICES

Abbreviated curriculum vitae for key project personnel.

DAVID JONATHAN COOPER

EDUCATION

Ph.D. University of Colorado, May 1983. Biology

Current Positions

2003-present. Senior Research Scientist/Professor, Department of Forest and Rangeland Stewardship, Colorado State University, Fort Collins, Colorado USA 80523 Phone: 970-491-5430 *David.Cooper@colostate.edu*

1996-present. Advising Faculty, Graduate Degree Program in Ecology, Colorado State University, Fort Collins, Colorado USA 80523.

2012-2018. Adjunct Professor, Department of Geography and Environmental Management, University of Waterloo, Waterloo, Ontario, Canada

2016-2018. Visiting Professor, Departmento de Recursos Hidricos, Facultad de Ingenieria Agricola, Universidad Nacional Agraria la Molina, Lima, Peru.

2015-present. Professorship under the Chinese Academy of Sciences President's International Fellowship Initiative, Beijing and Chengdu, China.

I have been principal or co-principal investigator on over 230 sponsored research grants/contracts at CSU totaling more than $14 million US

SELECTED RECENT PEER REVIEW PUBLICATIONS

David J. Cooper and David M. Merritt. **2012.**Assessing the water needs of riparian and wetland vegetation in the western U.S. USDA Forest Service, Rocky Mountain Research Station, RMRS-GTR-282

Cooper, D.J., R. Chimner, D. Merritt. **2012.** Western Mountain Wetlands. Chapter 22, In: Wetland Habitats of North America: Ecology and Conservation Concerns. Edited by: Darold P. Batzer and Andrew H. Baldwin, University of California Press. Pages 313-328.

Millar, D. **D. J. Cooper**, M. Ronayne. Groundwater dynamics in mountain peatlands with contrasting climate, vegetation and hydrogeological setting. **In press.** *Journal of Hydrology*.

McKernan, C. **D.J. Cooper**, W. Schweiger. The effect of glacial loss on riparian vegetation of alpine streams, Glacier National Park, Montana, U.S.A. *Freshwater Biology*. ***In press.***

Bultema, B. and **D.J. Cooper**. **2017**. Environmental drivers of subalpine and alpine fen vegetation in the southern Rocky Mountains, Colorado, USA. *Plant Ecology* doi:10.1007/s11258-017-0737-7.

Cooper, **D. J.,** K. Kaczynski, J. Sueltenfuss, S. Gaucherand, C. Hazen. **2017.** Mountain Wetland Restoration: The Role of Hydrologic Regime and Plant Introductions After 15 Years in the Colorado Rocky Mountains, U.S.A. *Ecological Engineering* 101: 46-59.

E. W. Schweiger, J. B. Grace, **D. J. Cooper**, M. Britten, B. Bobowski. **2016**. Beyond bioassessment: How does human disturbance influence wetland ecological integrity in Rocky Mountain National Park? *Ecosphere* 7: e01548. 10.1002/ecs2.1548.

Millar, D.J., **D. J. Cooper**, K.A. Dwire, R.M. Hubbard, J. von Fischer. **2016**. Mountain peatlands range from CO_2 sinks at high elevation to sources at low elevations: implications for a changing climate. *Ecosystems* DOI: 10.1007/s10021-016-0034-7.

Hribljan, J. D. **Cooper**, J. Sueltenfuss, E. Wolf, K. Heckman, E. Lilleskov, R. Chimner. **2015**. Carbon storage and long-term rate of accumulation in high altitude Andean peatlands of Bolivia. *Mires and Peat* 15: article 12, 1-14.

Crockett, A., M. Ronayne, D. **Cooper**. **2015.** Relationships between vegetation type, peat hydraulic conductivity and water table dynamics in mountain fens. *Ecohydrology*. doi:

Austin, G. and D. J. **Cooper**. **2015**. Persistence of high elevation fens in the Southern Rocky Mountains, on Grand Mesa, Colorado. *Wetland Ecology and Management*. DOI 10.1007/s11273-015-9458-7.

Wolf, E. C. and D. J. **Cooper**. **2015**. Fens of the Sierra Nevada, California: Patterns of distribution and diversity. *Mires and Peat* 15: Art. 8.

Cooper, D. J., E. C. Wolf, M. Ronayne, J. Roche. **2014**. Effects of Groundwater Pumping on the Sustainability of a Mountain Wetland Complex, Yosemite National Park, CA. *Journal of Hydrology:Regional studies* 3:87-105.

Shook, D, and D. J. **Cooper**. **2014**. Climatic and hydrologic processes leading to wetland losses in Yellowstone National Park, USA. *Journal of Hydrology* 510: 340-352.

Schimelpfenig, D., D. J. **Cooper**, R. Chimner. **2014**. Effectiveness of ditch blockage for restoring hydrologic and soil processes in mountain peatlands. *Restoration Ecology*. 22, 257-265.

Jeremy Robert Shaw
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Education

Ph.D. Ecology, Colorado State University (2015)
M.S. Watershed Science, Colorado State University (2006)
B.S. Forest Environmental Resources, University of Georgia (2000)

Recent Positions

2015-present. Research Scientist I, Colorado State University
2010-2015. Graduate Research Associate, Colorado State University
2007-2010. Water Resources Specialist, Arizona Department of Water Resources

Recent Grants

2016-2018. Development of Science-Based Mitigation Monitoring Plan Guidance, Protocols and Technical Standards - Hydrology Performance Standards. U.S. Army Corps of Engineers. $37,000.
2015-2018. Resource assessment, restoration, and erosion control at Navajo National Monument. National Park Service. $98,000.
2015-2018. Assessment of stream crossing impacts to ephemeral streams on military lands throughout the southwestern United States. U.S. Department of Defense, Legacy Program. $129,000.
2014-2017. Riparian restoration demonstration on the Howard Catonment Area of Yuma Proving Ground. U.S. Army Corps of Engineers. $73,000.

Selected Publications

Shaw, J.R., D.J. Cooper, and N.A. Sutfin. *In review*. Applying a hydrogeomorphic stream channel classification to understand spatial patterns in riparian vegetation. Submitted to Journal of Vegetation Science.
Kampf, S.K., J. Faulconer, M. Lefsky, J.R. Shaw, D.J. Cooper. *In revision*. Rainfall thresholds for streamflow generation in desert ephemeral streams. Submitted to Water Resources Research.
Shaw, J.R., and D.J. Cooper. *In revision*. Relative importance of abiotic and biotic limitations to seedling establishment of Sonoran Desert trees. Submitted to Journal of Ecology.
Nichols, M.H., C. Magirl, N.F. Sayre, and J.R. Shaw. 2017. The geomorphic legacy of water and sediment control structures in a semiarid rangeland watershed. Submitted to Earth Surface Processes and Landforms. DOI: 10.1002/esp.4287
Kampf, S.K., J. Faulconer, J.R. Shaw, D.J. Cooper, and N.A. Sutfin. 2015. Rain and channel flow supplements to subsurface water beneath hyper-arid ephemeral stream channels. Journal of Hydrology 536: 524-533.
Sutfin, N.A., J.R. Shaw, E.E. Wohl, and D.J. Cooper. 2014. A geomorphic classification of ephemeral channels in a mountainous, arid region, southwestern Arizona, USA. Geomorphology 221: 164-175.
Shaw, J.R., and D.J. Cooper. 2008. Linkages among watersheds, stream reaches, and riparian vegetation in dryland ephemeral stream networks. Journal of Hydrology 350: 68-82.

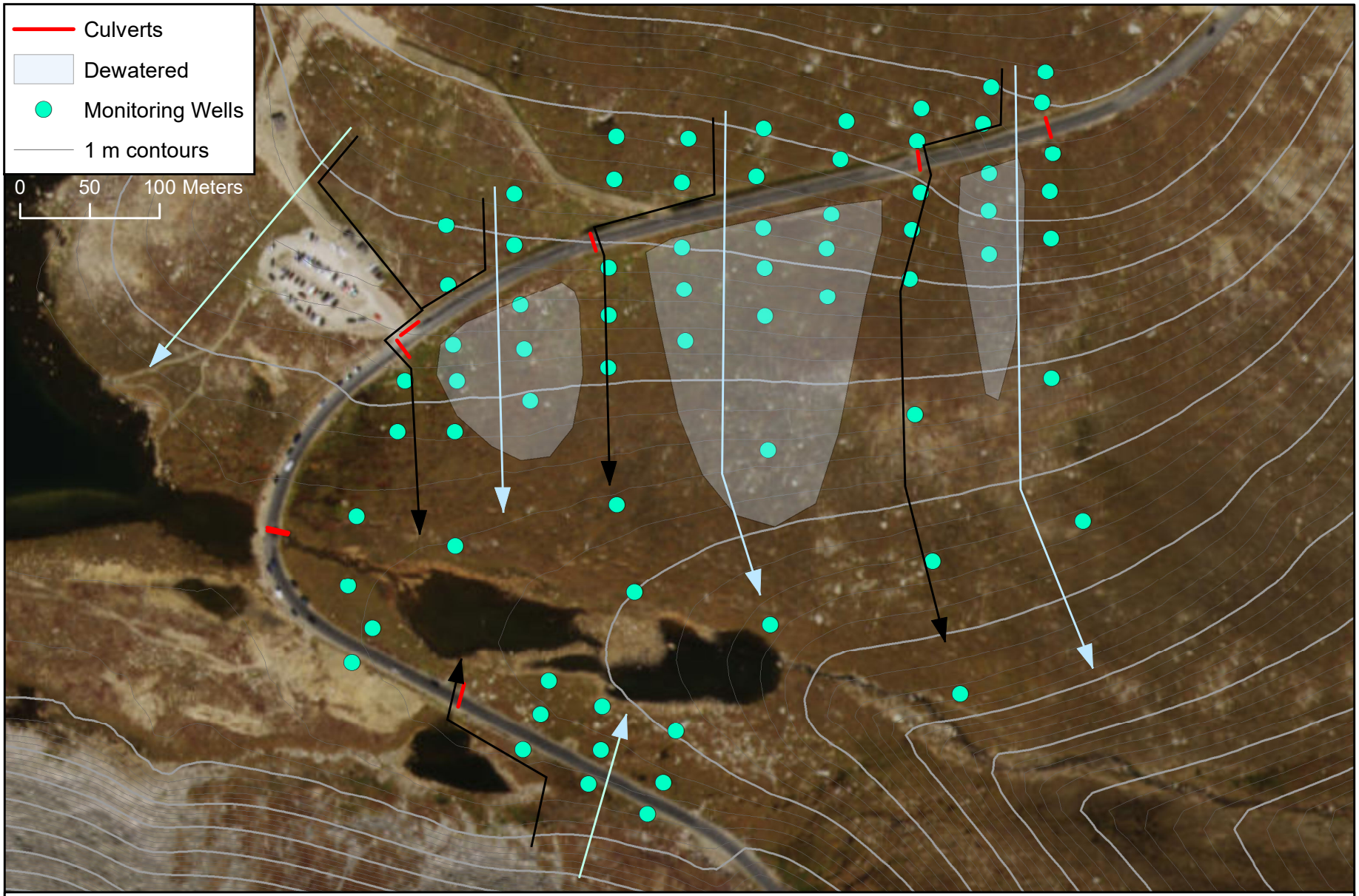

Figure 1. Schematic diagram of pre-development flow paths (white arrows), current flow paths affected by ditches and culverts (black arrows), and wetland areas that may be dewatered by flow path alterations. Also shown are locations of proposed monitoring wells and study plots (subject to change based on field conditions).

Supplement to Scope of Study

CDOT Study – Summary of Questions and Answers

1. What is the expected depth to the water table?
    a. We expect a range of summer water tables, but since we're working in wetlands, we expect water tables to be within 2 feet of the surface most of the summer.

2. What is the expected depth to bedrock?
    a. This of course is unknown, some bedrock could be shallow, some deep, some permafrost.

3. How will the wells be constructed (material, screen length, etc.)? And what are the chances that well construction could affect water quality sampling results?
    a. Wells are shallow and unlikely to be more than 3 feet deep. We construct wells by hand augering/digging, casing with Slotted 1.5 to 2" diameter PVC, and backfilling with the native soil. This type of well has no effects on water quality. The wells are developed by bailing so that the slots are unclogged.

4. How will water quality samples be collected? Seems like proper well development and purging would be critical for sampling in an alpine tundra environment.
    a. Correct. We are not assessing water quality per se, but will assess chemical content of the ground/surface water as it may influence vegetation composition.

5. Will all wells be the same, and allow for collection of 'clean' water quality samples?
    a. Yes all wells will have similar construction.

6. Is frost heaving a concern for shallow wells? Could this affect water level readings if collected over the winter?
    a. We are not worried about winter water levels as the vegetation is dormant and the ground likely frozen. We will reassess wells each spring to make sure there is no damage, replace damaged wells, and make sure we know the well height above the ground. The biggest challenge will be during the snowmelt season when there is abundant water on the surface.

7. How will the wells be protected from vandalism?
    a. We deal with vandalism on all of our project. We guard against this by painting the well casings to match the surrounding rocks and vegetation to make them barely visible. Regular/standard well caps will be used.

8. Given the shallow depth of these wells (about 3 feet) does the State Engineer's Office require they be registered? If so, please list CDOT as owner.
    a. We will verify the need for registration, but typically for shallow short term wells they do not need registration. See below for further detail; the City will reply on CDOT's expertise.

9. Are data loggers stand-alone units within each well, if not how will this be configured?
    a. The data loggers are battery operated, submerged and hidden down in the wells.
10. Please confirm that CDOT will remove the wells and properly abandon them per State Engineer's rules.
    a. We will remove all wells not needed at the end of this process. When we dig wells we save all the soil, and store it adjacent to each well. So when we pull them we backfill with the native material that came from each borehole. See 8.aC=continued, below.

11. Please confirm that a permit is not needed by the Army Corps of Engineers, or obtain the permit.
    a. COE permits are not needed to install monitoring equipment as we are not placing fill material into waters of the U.S. A Section 404 Permit is not needed install or remove the wells.

12. Understand that the tracer to be used is still to be determined, and want to be sensitive to potential public concerns (i.e. mistaken for spilled antifreeze). Also, want to sensitive to tracer, elk, sheep, and other fish and wildlife frequent the area.
    a. We understand and have the same concerns and will only do the tracer work if we find a tracer that will be acceptable to all parties.

13. If bromine/ide is used as a tracer, conceivable exposures could occur to: elk and sheep drinking from the wetland complex and Bear Creek; fish and other aquatic life throughout the stream/wetland system; and to algae/riparian plant community. Can you expand on risks posed beyond what is in the study proposal?
    a. We will do more research on the bromide but it is used specifically because it has no effects on fish, aquatic invertebrates or mammals.

14. Would it be an option for the City to coordinate sampling activities with CDOT so that we may collect additional data on historical and current privy indicators (nutrients, caffeine - still to be determined)? Our location of interest would be primarily in the northwest quadrant. A couple wells outside of that area could serve as controls.
    a. Yes, we can share the wells with Denver Mt. Parks (DMP), CDOT, and others. If desirable, we could be there when DMP wishes to collect samples, or we could collect samples and deliver them to DMP.